1568/119.

# JOURNAL

OF A

# TOUR to ITALY.

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CONTAINING,

(Among many other intereſting and curious Particulars)

An Account of the Eruptions of Mount Veſuvius.
Of the Curioſities diſcovered at Herculaneum.
Of the leaning Towers of Piſa and Bologna.
Detection of the Impoſitions uſed in the pretended liquefying of the Blood of St. Januarius.
Parallel between the Horſe-races at Rome and New-market.
Deſcription of Port Specia and the neighbouring Coaſt.
Of the famous Emerald, or Holy Veſſel, at Genoa.
Remarks on the Mountains and Ice Vallies of Swiſſerland, &c. &c.

By M. de la CONDAMINE.

*DUBLIN:*

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TO

# JAMES WEST, Eſq;

Fellow of the Royal and Antiquarian Societies, Honorary Truſtee of the Britiſh Muſeum, Repreſentative in Parliament for the Borough of St. Albans, &c. &c.

SIR,

IF favours received are any title to acknowledgements of this ſort, I know of no one who has a better claim to them at my hands. If a confeſſed fine taſte for the polite arts in general, with a conſummate knowledge of the ſubjects here treated of in particular, are qualifications that conſtitute the requiſites of a patron, I know of no one at whoſe hands I can more properly apply than at your's. In either caſe, therefore, Sir, this addreſs will have a peculiar propriety. The firſt the world will readily allow me to be the beſt judge of. For the truth of the ſecond I appeal to thoſe illuſtrious ſocieties of which you have long been ſo diſtinguiſhed a member----to that noble collection of ſcarce and valuable tracts in all languages and ſciences, which take up no inconſiderable part of a very large manſion, and which it requires no vulgar hand to ſelect---to thoſe beautiful cabinets of medals in your poſſeſſion, in which we ſee diſplayed ſuch a regular ſeries of the moſt important events of antiquity, and many of which are hardly to be met with in any other collection, either public or private, now in being---in ſhort, Sir, to the teſtimony of all who have either had the happineſs of knowing you, or have ever heard, with the leaſt degree of preciſion, of your name.

It might be ſuſpected, perhaps, that I am here running on according to the too general practice of dedicators, in extolling virtues which owe their exiſtence to the imagination of the writer, who has at once created and magnified them for his own ends. But, Sir, there are two very powerful reaſons, which I think muſt ſcreen me from an imputation of this ſort: the firſt, that I ſpeak of well known facts; the ſecond, that I fancy you will be at a very great loſs to know from whom, of the many perſons who lie under obligations to you, this preſent addreſs comes.

You muſt give me leave, Sir, likewiſe to add, that however ſorry for it I may be, conſidered in a public light, it affords me a very ſingular pleaſure as an individual, that I am able to addreſs you, Sir, on this occaſion, when the reſignation of that honourable poſt, which you diſcharged for ſo many years with ſuch ſignal credit to yourſelf, and ſuch advantage to the publick, puts it out of your power to beſtow the leaſt gratification upon your friends, and conſequently renders it the moſt improper time that I could have choſen, for a dedication founded upon intereſted views. For how readily ſoever I can reſign all pretenſions to fame as a writer, I ſhould be ſorry to have it thought that I have not a Spirit above any thing that is mean or ſervile; and as I have long known the indignity with which the ignorant, but more ſucceſsful part of mankind, are apt to treat the whole race of authors, it would grieve me not a little to let drop any thing on this occaſion, that could tend in the leaſt to depreciate them in the eyes of the vulgar.

To conclude then, Sir; you are requeſted to accept of the following performance, as the humble offering of a grateful heart---as a work which, from the name of the author, and the nature of the ſubjects it treats upon, will probably be no diſagreeable preſent to you---and as a very ſmall token of that great reſpect with which I have the honour of being,

Sir,

Your obliged and

Very obedient

Humble Servant,

The TRANSLATOR.

# PREFACE.

THE name of M. de la Condamine is already ſo well known in the learned world, that it is almoſt unneceſſary to ſay any thing here in favour of his abilities. While aſtronomical reſearches are thought worthy regard, his menſuration of a degree of the Equator will not be forgotten; and though the differences which aroſe between the gentlemen employed on that occaſion, rendered theſe menſurations in ſome meaſure imperfect, yet every one who is in the leaſt converſant with the particulars of the voyage, knows that a very conſiderable ſhare of the perfection they have is due to the indefatigableneſs, accuracy, and uncommon qualifications of M. de la Condamine.

Nor is it in aſtronomical reſearches alone that he has ſhown himſelf thus excellent, but almoſt in every other ſpecies of ſcience. In the Journal now before us, we know not whether moſt to admire, the philoſopher, the ſcholar, or the complete

plete connoiſſeur; qualifications which, though ſeldom united in one perſon, yet all ſhine ſo eminently in him, that we are at a loſs to ſay in which he ſhines moſt.

To this happy union of talents it is to be attributed, that in a road already worn ſo bare by frequent enquiries, he has been able to furniſh us with ſo many new diſcoveries. For every thing to ſuch a mind affords matter of obſervation; and if on any occaſion he touches upon ſubjects that have been treated of before, his method of handling them is ſo entirely new, and his remarks ſo removed out of the common way, that we only wiſh he had touched upon ſuch ſubjects oftener, as they would undoubtedly have furniſhed us with opportunities of oftener admiring him.

To inſtance only in the Lava of Veſuvius, what a noble field of philoſophy has he opened to us there! a new ſyſtem of worlds blazing forth upon us, and that not founded upon mere hypotheſis and abſtruſe ſpeculation, but upon facts which carry almoſt the force of demonſtration along with them!

Nor are our gentlemen of the turf at all leſs obliged to him than the curious enquirers into the ſecret works of nature. Hitherto we have been taught to look upon the arts of the courſe in a contemptible light, but M. de la Condamine has ſhown them to be perfectly reducible to the graver rules of philoſophy; from henceforward, therefore, we may expect to ſee ſages themſelves not diſdain to appear at a horſe-race, and our very ſquires and jockeys determining the velocity of thoſe uſeful animals, not by make or ſize, but upon the moſt profound principles of the mathematicks. We may expect to ſee the doctrine of *betting* rendered, at leaſt, as eaſy as that of any other game of chance; and ſome future HOYLE, perhaps ariſe, who from the force of the obſervations here laid down, and the aid of a few figures, ſhall teach our *ſporting* gentry to judge as well for themſelves in this kind of ſcience, as his name-ſake of immortal memory has done, in the very profound games of whiſt and quadrille.

But raillery apart, amidſt the many uſeful as well as agreeable diſcoveries made by our Aurhor, it muſt afford every true Chriſtian a very ſenſible pleaſure, to ſee that dangerous impoſition of the church of Rome, which is every year ſo ſhamefully repeated in the pretended liquefaction of St. Januarius's blood, here ſo evidently overthrown and refuted. How a profeſſed papiſt durſt do this, I own is matter of ſurprize to me; but that it was done by a papiſt, at the ſame time that it is a moſt convincing proof of his own candour, is one of the happieſt circumſtances in favour of that undiſguiſed branch of the Chriſtian religion which we profeſs, that could poſſibly have happened.

To conclude: as no perſon ſeems better formed by nature to make thoſe enquiries, which the imperfection of all human wiſdom ſtill leaves but too much room for, ſo nobody ſeems ever to have made them with more unremitted ardour and aſſiduity. Nor is his modeſty, wherever he has occaſion to mention himſelf, any ways inferior to his abilities. But candour, truth, and humility ſeem to have followed him wherever he went; and to theſe amiable qualities, no doubt, as well as to his uncommon ſhare of learning are to be attributed thoſe great honours he met with from the eminent in every country through which he paſſed. There is but one thing that I know of in which the bulk of mankind have reaſon to be diſpleaſed with him; and this is, that when we ſee ſo many of them, particularly of our Engliſh gentry, taking much longer tours, from which, nevertheleſs, they return empty, though poſſeſſed of all the neceſſary means of improvement, M. de la Condamine, who ſet out in an ill ſtate of health, and unprovided of any ſuch advantages, ſhould furniſh out at once ſuch an agreeable and inſtructive narrative, as will for ever do honour to his memory.

# ADVERTISEMENT.

AS two or three terms occur in the following Journal, which it is impoſſible to tranſlate well into any other language, for the benefit of the mere Engliſh reader, we ſhall here endeavour to explain them as well as we can. Our more learned readers, for whom this explanation is not intended, will excuſe us.

*Facet*, or *Facette* (the diminutive of face) ſignifies, in jewelry, the ſeveral little ſuperficies into which a ſtone is cut. Theſe are often, though improperly, called *ſquares*, being for the moſt part either *triangular* or *lozenges*.

*Goutte de Suif*, in Engliſh, *a tallow drop*, is uſed to expreſs the ſurface of a chryſtal, or other ſtone, cut in the rounding to the ſame degree as a drop of tallow on a plane.

*En creux*, or *in hollow*, in jewelry, ſilver work, &c. is the reverſe of *emboſſed*, in ſculpture, of *relief*. Thus in the former a coat of arms, &c. may be ſaid to be cut *en creux*, when engraven in the ſtone; and ſo likewiſe of the latter, when the figures are not raiſed above the ſurface. In moulding it ſignifies the *hollow* form of the plaſter that has been laid on any *raiſed* piece of work, in order to take off the impreſſion.

*Relievo*, or *relief*, the oppoſite of the foregoing, is applied in jewelry, ſculpture, &c. to ſuch figures as are raiſed above the ſurface of the work. Of this there are two kinds; the firſt called *bas* (or *low*) *relief*; the other, *haut* (or *high*) *relief*; which differ from each other only in their greater or leſs degree of prominency. The Italians diſtinguiſh them by the epithets of *baſſo* or *alto*, often to be met with in Engliſh writers.

*Biſeau*, or *bizzel*, in precious ſtones, is when they are cut with a long plane, the length of the ſtone; or, if round, as in a picture or watch-glaſs ſignifies a plane round the edge, terminating the rounded ſurface. Thus table diamonds and other precious ſtones are ſaid to be cut *en biſeau*, when they have no *facettes* expreſſed on them. It ſometimes alſo ſignifies the hollow rim or moulding of a ſocket made to receive a ſtone. In all other arts, where the chiſel is uſed, it conveys pretty nearly the ſame image.

# JOURNAL
## OF A
## TOUR to ITALY.

IN a Tour, wherein the re-eſtabliſhment of my health was at firſt my only object, unprovided of inſtruments, which I even avoided carrying with me, I was not able for the moſt part to make any other obſervations, than ſuch as offered themſelves to me of their own accord, and which it required only eyes to ſee.

I ſhall not ſeek, therefore, to excuſe myſelf, if I bring not back a more ample harveſt from ſuch a country as Italy, where nature and art preſent a field ſo vaſt to the curioſity of a traveller. As for thoſe maſter-pieces of ſculpture, painting, and architecture, as well antient as modern, which are to be found there, we have already deſcriptions of them by a maſterly hand: Beſides, it is my duty to confine myſelf in a memoir of this nature to matters which are more particularly the province of this academy. I ſhall preclude myſelf, therefore, as foreign to my object, from every detail relative to the fine arts and ancient monuments, at leaſt unleſs phyſicks or the mathematicks are particularly intereſted therein.

I ſet out from Paris on the 28th of December, 1754. The 7th of January following, at the very inſtant that I was going to embark at Lyons, in order to fall down the Rhone, that river, being covered with ice, in ſpite of its rapidity ceaſed any longer to be navigable. A few days after, I ſaw carriages traverſing that branch of it which bathes the walls of Avignon. I learned alſo that it was the ſame with the branch which ſeparates the city of Arles from Languedoc, and that the ſurface of the other was entirely frozen over: An uncommon event, of which hiſtory furniſhes very few examples.

It appears that the cold of the winter between the years 1754 and 1755, was ſeverer in our ſouthern provinces, than in the North of France. The liquor of two thermometers, divided into degrees according to the method of M. de Reaumur*, the one of ſpirits of wine, the other of mercury, being expoſed to the air, fell at Lyons, on the 17th of February, to between ſixteen and ſeventeen degrees below the point of freezing; which is about two diviſions lower than the ſame inſtrument fell at Paris during the celebrated winter of 1709. Another thermometer of the ſame conſtruction, in a cloſet expoſed to the South, deſcended at Arles to the twenty-ſecond degree; while at Marſeilles, in a latitude ſomewhat more northern, but in a ſituation more ſheltered from the North winds, a like thermometer ſcarce attained

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* In the obſervatory of Father Beraud, a Jeſuit, profeſſor of mathematicks in the great college of Lyons, and correſpondent of the Academy of Sciences.

to $4\frac{2}{3}$ degrees beneath the point of freezing, and that only once in the ſame winter; that is to ſay, on the 7th of January in the morning before the riſing of the ſun *. The ſame day, inſtruments of the like conſtruction marked ſeven degrees at Montpellier, and eight at Niſmes.

In the memory of man they had never ſeen before at Montpellier two feet depth of ſnow. All the neighbouring fields, as far as the ſight could extend, were ſtill ſo covered with it in the beginning of February, that it reached in ſeveral places up to the middle of the wheels of my chaiſe. Languedoc and province preſented me with an aſpect of the ſummit of the Cordilleras of Peru. The verdure of the hedges and olive-trees, which even winter ſtrips not there of its leaves, had now entirely diſappeared beneath the ſnow: No other object met my eyes. A Laplander would not have believed himſelf out of his own country.

The Pont du Gard, the ancient temple vulgarly called the Square-Houſe, the Amphitheatre,

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* The latitude of Montpellier is about $43^{d}\,36'\frac{1}{2}$; that of Arles $43^{d}\,40'\frac{1}{2}$; that of Marſeilles $43^{d}\,18'$.

phitheatre, all thoſe beautiful remains of antiquity at Niſmes and its environs, comparable even to the moſt remarkable of the kind that Italy itſelf preſents, enter not, as I have already ſaid, into the plan of this memoir: But can a traveller who takes up the pen, at leaſt unleſs he be blind, or a miſanthrope, paſs over in ſilence the beauty, the convenience of our high-ways, now become perfect walks? An advantage of ſuch importance to a ſtate, and which ſo many people enjoy without knowing the value of it; an advantage reſerved for our age, our country, and the preſent adminiſtration; an advantage ſo envied France as happily to excite the emulation of all her neighbours: The many labours of this kind which I have ſeen in Piedmont, Tuſcany, and the Eccleſiaſtical State, are witneſſes hereof; but theſe laſt approach by no means in goodneſs, if we may believe common fame, to thoſe admired ones on the new road from Trieſte to Vienna, opening through the very middle of the mountains of Iſtria and Friouli, under the auſpices of the empreſs-queen with a magnificence worthy the ancient Romans.

Why do we ſtill heſitate to adorn the ſides of all our high roads with boundaries placed at equal diſtances? an ancient cuſtom, of which we cannot ſufficiently extol the agreeableneſs and utility; a cuſtom eſtabliſhed among divers of the modern nations in the Eaſt, and which it is aſtoniſhing that all Europe has not yet adopted. This cuſtom has juſt introduced itſelf into the papal territories by the orders of the reigning pontiff[*]: An inſcription to be read on a bridge as we draw near to Rimini, points out, with an elegant and Laconic ſimplicity, the deſign of theſe boundaries: Viatorum ſolatio & commoditati: for the conſolation and convenience of travellers.

The ancients contented themſelves with marking on their ſtones the number of miles, to be counted from the Capitol[†].

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[*] Benedict XIV. who died in 1758.

[†] The method obſerved in this reſpect by the Romans admits of ſome debate. Tacitus informs us, that they computed their miles from a golden pillar (χρυσοῦν μιλιον, though, by the way, it is ſaid to have been only of white marble, about eight feet high, with a gilt ball at top, from whence it is ſuppoſed to have obtained the epithet of golden) erected by Auguſtus near the temple of Saturn, at Rome. From

They have improved on this cuſtom in the new boundaries placed along the high roads of Languedoc, by order of the ſtates of that province, and under the direction of M. Pitot of this academy. Theſe boundaries are ſquare, four feet above the earth, and have one of their angles turned towards the road, in ſuch a manner, that a paſſenger diſcovers at once the two faces of this ſaliant angle. On the one, he reads how many thouſand toiſes he has travelled ſince the morning, and on the other how many thouſand toiſes remain to be compleated before night. The ſum of theſe two numbers ſhews the diſtance of the two places, which are the ordinary days journey of the traveller.

Another example of the ancients, reſpecting their highways, would perhaps be worthy of imitation. I have obſerved in thoſe remains of their roads which are yet ſubſiſting,

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From this column, ſtones were placed at equal diſtances throughout all the high roads of Italy. Now the queſtion among the learned is, whether the numbers, II, III, &c. marked on theſe ſtones denoted as many miles from the city, or only the ſecond and third ſtone from the above-mentioned pillar, whereon was engraven figure I. This laſt opinion has the greateſt number of followers. *Thomas's Eutropius.*

ſubſiſting, that the joints of the large ſtones wherewith they are paved, are never placed in the ſame direction with the highway; a circumſtance by which it comes to paſs, that the wheels of carriages meeting with the joints in no other poſition than obliquely, tend of courſe leſs to diſunite the ſtones *.

At my return from Montpellier to Avignon, where I made a ſecond ſtay, I found there her Royal Highneſs the Margravine of Bareith, ſiſter to the king of Pruſſia, who paſſed the winter in that city. I admired in this princeſs thoſe marks of knowledge and talents ſo very uncommon in perſons of her ſex and rank. I ſaw in the hands of one of her ladies of honour a watch-caſe, cut facet-wiſe, which reſembled poliſhed ſteel; on examination, I perceived that the matter whereof it was made, was

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* A tryal of this has been made in the environs of Paris; but there ſome inconveniencies were found to ariſe from it, proceeding perhaps from the ſmallneſs of the ſtones with which our high roads are paved, they being only eight inches ſquare; but principally from the increaſe of labour, which the neceſſity of ramming down the ſaliant angles of theſe pavements demands, in order to render the two ſides of the cauſey even.

was not unlike that ſpecies of mineral ſtone of which great numbers are found in the ancient ſepulchres in Peru. They are plain and ſmooth on one ſide, convex and conick on the other, and known in that country under the name of the Inca's Looking-glaſſes. It is a ſort of pyrite which ſtrikes fire with ſteel. This matter has nothing metallick in it, though it has all the appearances thereof. It receives the fineſt poliſh, and is not ſuſceptible of ruſt; which made me imagine it might be proper for making ſpecula for reflecting teleſcopes: but though I brought back ſeveral pieces of it, cut at Quito, ſome en gouttes de Suif, others brilliant, fit for making buckles or buttons, I never could find at Paris any workmen who knew how to poliſh the rough fragments well, which I put in their hands. It has beſides a yellowiſh tint, which would infallibly alter the colour of objects. Germany has mines of this matter; and I learned that the watch-caſe which I ſaw before my eyes, had been cut at Bareith, where they find alſo ſeveral ſpecies of coloured flints; and among others, a yellow one on a gray ground, of which they make beautiful cameos. With reſpect to the watch-caſe made of pyrite, the matter of it appeared to me much leſs beautiful, and of a leſs lively poliſh, than thoſe pieces which I brought from Quito.

I afterwards rejoined, in my ſeveral excurſions in Italy, the margravine, and the prince her ſpouſe. The preſents with which they honoured me, and thoſe diſtributed by them in the places where they made any ſtay, have frequently furniſhed me with an opportunity of obſerving the ſkill of the German workmen in an art too much neglected by us, that of cutting en creux, as well as in relief, flints, agates, jaſpers, porphyries, lapis lazuli, cornelians, emeralds and amethyſts; and of repreſenting, by incruſting theſe ſtones one upon another, flowers and animals in relief, with their natural colours.

The great quantity of marble employed in their edifices was the firſt thing which ſtruck me in Italy. Temples and palaces, caſed with white marble, are very common at Genoa.

In the treaſury belonging to the cathedral of that city is preſerved, with the greateſt veneration, for upwards of ſix hundred years, a diſh, or rather an hexagon bowl, which they pretend to be made of emerald. It has two ſmall handles, and conſiſts of one ſingle piece: its greateſt diameter is about fourteen inches and a half; its height, five inches nine lines; its thickneſs, three lines. This monument is kept under ſeveral keys, depoſited in different hands. When it is ſhown, which happens but ſeldom, and by virtue only of a decree of the ſenate the veſſel is let down by a cord, paſſed through its two handles, and ſuſpended around the prieſt's neck, who preſides at the exhibition; but never goes out of his hands. By an ancient decree of the ſenate, bearing date the 24th of May 1476, it is forbid under ſevere penalties, to approach too near this ſacred veſſel [il ſacro catino,] and much more to touch it with any metal whatſoever. All this apparatus and theſe difficulties ſeem only ſo many precautions taken againſt thoſe who might want to ſatisfy themſelves by ſome proof, ſuch as that of the file, or graving-tool, whether the matter of which this veſſel is compoſed, be really of the hardneſs of an emerald.

Nevertheleſs they produce an act, by which it appears that the veſſel was pledged by deliberation of the ſenate, in 1319, during the ſiege of Genoa, to cardinal Luke de Fieſqui, for a ſum equivalent to twelve hundred marks of gold, and that this ſum was paid off and the pledge withdrawn twelve years after. This ſeems to prove, that the great value of the matter of this depoſit was at that time without ſuſpicion.

I ſee not what preſumption in favour of the matter of this veſſel can be drawn from the circumſtance of one of its handles been cracked; nor how this proof, which is ſuppoſed to have been made in the preſence of the emperor Charles V. could aſcertain the genuineneſs of the emerald.

The princes Corſini, grand nephews to pope Clement XII. whom I had the honour of accompanying from Marſeilles to Genoa, having obtained from the ſenate the neceſſary decree to ſee this monument, I availed myſelf of the opportunity in order to examine it. I viewed it attentively, oppoſing it to the light of a large taper. The colour appeared to me a very deep green: I perceived not in it the leaſt trace of thoſe icicles, ſtraws, clouds, and other defects of tranſparence ſo common in emeralds and all other precious ſtones of the leaſt thickneſs; even in rock chryſtal; but I diſtinguiſhed very evidently ſeveral little voids, reſembling ſmall bubbles of air, of a round or oblong form, ſuch as are commonly found in chryſtals, or glaſs, whether white or coloured.

One would not expect that a prejudice of the twelfth century ſhould be blindly reſpected in the eighteenth; nevertheleſs I know not that any modern traveller has combated it; and the Geographical Dictionary of Martinere, edition 1740, ſays poſitively, "that they preſerve at Genoa a "precious veſſel of ineſtimable value," which aſſertion I am the more aſtoniſhed at, as my doubt is by no means new. It is clearly indicated in the expreſſions employed by William archbiſhop of Tyre, about four centuries ago, where he ſays, that at the taking of "Cæſarea this veſſel "fell by lot, for a large ſum of money, to "the Genoeſe, who believed it to be an "emerald, and who ſhow it ſtill as ſuch, "and as ſomething wonderful, to ſtran-

"gers.*" For the reſt, it belongs only to thoſe whom theſe ſuſpicions may diſpleaſe, to deſtroy them, if they are not well founded; and I have not entered into this detail, but in the hope that a fact, the clearing up of which is ſo eaſy, will not remain any longer in obſcurity; or that this obſcurity, if it ſhould continue, will change theſe ſuſpicions into certainty.

I drew the figure and dimenſions of the veſſel of Genoa, ſuch as I now lay them before this aſſembly, from a work publiſhed at Genoa in 1726, by a religious of the Auguſtine order, and filled with hiſtorical reſearches on this ſubject. The author leaves undecided the queſtion which he propoſes to himſelf, whether this precious moveable was brought by the Genoeſe from the ſiege of Cæſarea in Paleſtine, in the year 1101 (as appears evident by the teſtimony of William of Tyre) or from the ſiege of Almeria, taken by the Moors in 1147; but he diſcuſſes with great erudition through what hands the veſſel has paſſed, ſince the queen of Sheba made a preſent of it to Solomon, to the time wherein it was employed to ſerve up the paſchal lamb to our Saviour on the eve of his paſſion: this is a point on which our author has not the leaſt doubt. As for what reſpects the matter of it, he maintains that it is certainly an emerald; and his ſtrongeſt argument is, that the matter of a veſſel which ſerved for the ſupper wherein our Lord inſtituted the auguſt ſacrament of the Euchariſt, could not be too precious. This principle once admitted, would lead the author farther than he deſires, and prove that the diſh ought to be a diamond.

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* *Januenſes . . . . Smaragdinum reputantes, pro multa pecuniæ ſumma in ſortem recipientes . . . . uſque hodie tranſeuntibus. . . . Vas idem quaſi pro miraculo ſolent oſtendere, &c.* Guill. Tyr. Archiepiſc. Lib. X. Cap. XVI.

I ſaw at Rome, in the hands of M. Aſſemani, prelate of the Maronites, and keeper of the Vatican library, two tranſparent ſtones, of a very beautiful green colour. I learned from him that he had brought them from Egypt, and that they were taken out of a large block which he ſaw entire. The largeſt of thoſe pieces is about ſix inches long, by three and a quarter broad, and two or two and a half thick. They are looked upon as emeralds. This I can certify, that they have the hardneſs of one: The graving tool which I applied to them left no marks behind: they are beſides of a great clearneſs: the colour is by much leſs deep, though on a greater thickneſs, than that of the diſh of Genoa: the tranſparency of it is every where equal: in ſhort I obſerved not in it the leaſt defect; a circumſtance, it is true, very rare in emeralds, even of a leſſer bulk; but what is ſtill more, I perceived not in it the leaſt bubble of air, a defect ſo common in caſt glaſs. Theſe two pieces are nothing in compariſon of a ſtone of the ſame colour, weighing upwards of twenty pounds, and of a quadrangular form, which is kept in the convent of Riechenau, near Conſtance, being a preſent of Charlemagne's to that abby. It is pretended that the Monks made a conſiderable ſum of the fragments alone, but were not able to obtain the permiſſion of the emperor Charles VI to ſell the reſt. I have never ſeen this ſtone; but its figure, and the dimenſions of the block are to be found in Keyſler's German Travels, printed at Hanover in 1740*.

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* The emerald our author here alludes to is in ſize larger than a common folio, two inches thick, and weighs twenty-eight pounds three quarters. See Buſchin'gs

We know not now-a-days of any other emeralds than thoſe which are drawn from America, or the new kingdom of Grenada. Hiſtorians relate, that at the time of the diſcovery of the new world, the Spaniards found great numbers of them at Puerto Viejo, and Manta, on the coaſt of Peru, in the province of Quito. It is pretty ſingular, that even the tradition of this ſhould now be loſt; but that I can aſſert for a truth, after ſtrict enquiries which I made in the country. The River of Emeralds, which I travelled up to its ſource, the Indian hamlet ſituated near the mouth of it, the little mountain, in fine, the very province of which the late Don Pedro Maldonado, my companion in the voyage up the river Amazons, was governor, all theſe places bear ſtill the name of Eſmeraldas, but preſerve only the name. Not the leaſt veſtige is to be ſeen there of the antient works; and if there ever have been any, the memory of them is entirely loſt among the natives of the country.

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Buſching's Geographical, Engliſh tranſlation, vol. 5th. page 165.

We are as little inſtructed in the natural hiſtory of the emerald, and in the difference of the occidental and oriental ones, whoſe very exiſtence Tavernier denies. We know as little of the places from whence the antients drew theirs. What we read in Herodotus and Pliny, of the prodigious bigneſs of ſome of them, appears ſo remote from any likelihood of truth, that it were to be wiſhed, at leaſt that what concerns the largeſt and moſt celebrated emeralds now in Europe, were well known and thoroughly ſettled.

Almoſt all the rocks on the coaſt of the ſtate of Genoa, are of ardoiſe or marble. A little beyond theſe we find at about a league's diſtance from the ſea, in the principality of Maſſa, the ſmall city of Carrara, a new Paros, from whence they draw a beautiful marble, which we name Carrara, the whiteſt and moſt proper of any for ſculpture.

In paſſing from Genoa to Lerici on board a felucca, I entered the gulph of Specia, where I ſaw a ſpring of freſh water in the midſt of the ſea. This gulf, on the borders of which are ſeen the ruins of the ancient city of Luna, deſtroyed by the Saracens, forms the moſt beautiful and largeſt port of the Mediterranean, and perhaps of the whole world. It is of this port that Silius Italicus ſaid,

> ———Quo non ſpatioſior alter
> Innumeras cepiſſe rates, & claudere
> pontum. Lib. viii. V. 481.

It comprehends within its ſweep, and in its bays, ſeveral other ports: two naval armaments may lie there at anchor, without ſeeing each other.

The port of Leghorn, its advantageous ſituation for commerce, and the protection of the great dukes of Medicis, have raiſed, in leſs than two centuries, from a hamlet to a flouriſhing city, and peopled with 40,000 inhabitants; tho' ſituated on a coaſt deſert, marſhy, and unhealthy, as the greateſt part of the maritime towns of Tuſcany and the Eccleſiaſtical State are. This example proves, that with care, expence, and a ſettled ſyſtem of government (conditions difficult to aſſemble together) the moſt unhealthy countries may become habitable, cultivated, and fertile.

The excavations which public works bring along with them, are almoſt always the occaſion of ſome new diſcovery in the foſſil kind. The labours created by the port of Leghorn greatly enriched the celebrated cabinet of the chevalier de Baillon, which the emperor has purchaſed, and which that prince cauſed to be tranſported from Florence to Vienna a few years ago.

His imperial majeſty ſends into all parts of the world naturaliſts and draughtſmen in order to gather new harveſts. In my way to Marſeilles, I received a viſit from a young Dutch phyſician, who was on the point of embarking with two aſſiſtants for Spaniſh America: He was charged to make collections there of every kind for the emperor's cabinet at Vienna.

His imperial majeſty's taſte for natural hiſtory is ſo ſtrong, is ſeconded with ſo much zeal by his ſubjects, that his cabinet, formed in a few years, bears the palm at preſent, in the mineralogic part, according to the teſtimony of a very intelligent and indiſputable witneſs, from the two moſt celebrated cabinets in Europe taken together; to wit, that of his moſt Chriſtan majeſty, and the Britiſh cabinet purchaſed of the heirs of Sir Hans Sloane by the government of England. A powerful prince has but to deſire, natural difficulties ſmooth themſelves before him, and moral impoſſibilities diſappear.

Tuſcany abounds in minerals and in foſſils of every kind; cabinets of natural hiſtory are more common there than in other parts of Italy. The marquis Ginori, governor of Leghorn, has purſued his enquiries for ſeveral years paſt, with conſiderable labour, into the earths, ſtones, minerals, and all the foſſils of the country. He has ſhown me his tables, containing the reſult of his ſeveral experiments on matter vitrifiable and calcinable, pure and mixed in different proportions, ſubjected to the fire or ſubmitted to the action of various diſſolvents. In the manufactory of Porcelaine, eſtabliſhed at his expence at Florence, pieces are made of very conſiderable bigneſs. I have ſeen there ſtatues and groupes half as large as the life, modelled after the moſt beautiful antiques. His furnaces are made with a great deal of art, and caſed with bricks of the ſame materials with the porcelaine. The clay of this is very beautiful; and one might perceive in the grain of the broken pieces all the qualities of the beſt porcelaine from China. They wiſh indeed to that of Florence a whiter varniſh for the ground; and this perfection would not probably be wanting to it, if the marquis Ginori had not made it a law with himſelf, to employ no other materials than thoſe which he draws out of the very country *.

I ſaw, in a cabinet at Leghorn, a piece of the jaw-bone of an elephant, petrified into agate, and weighing near twenty pounds. I have ſpoken elſewhere of a grinder [it was not known of what animal] weighing between two and three pounds, in like manner converted into agate, and found at Tucuman, in North America, where there are no elephants. It made part of a conſiderable cargo, the loſs of which I have already deplored, conſiſting of a pretty large number of ſcarce pieces, deſtined

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* The marquis of Ginori is dead ſince the reading of this memoir; and I know not into what hands his papers and the tables containing the reſult of his experiments are fallen.

deſtined for the king's cabinet, which I addreſſed to the academy by way of the late M. de Fay, and embarked at Callao, the port of Lima, on board a veſſel which ſailed for Panama on the 2d of May 1737 *.

At another perſon's in Leghorn I ſaw three ſmall animals, which they call in Italy Taupes de Carthage. They are like ſquirrels: Their two four-paws are very ſhort, and ſerve them inſtead of hands; they go only by leaping on their hind-feet. It appears that Ariſtotle and Theophraſtus knew this animal; we find a very minute deſcription of them in the Tuſcany magazine of 1755, a periodical work, which appeared monthly, under the direction of the Abbe Venuti, provoſt of the church of Leghorn, and aſſociated-ſtranger of the academy of Belles-Lettres at Paris, who deſired that I would lodge with him during my abode at Leghorn.

I arrived at Piſa on the very night of the eclipſe of the moon of the 27th of March 1755. M. Perelli, profeſſor of aſtronomy in

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* See the hiſtorical journal of a voyage to the Equator, publiſhed at the Louvre in 1750, note, page 104.

in the univerſity of that city, communicated to me the phaſes which he had obſerved, and ſome other remarks; ſuch as the latitude of the obſervatory of Piſa, which in 1753 was $43^{d}\ 43^{\prime}\ 1^{\prime\prime}$, and the obliquity of the ecliptick, which was 23d $28^{\prime}\ 19^{\prime\prime}$.

Piſa has loſt much of its ancient ſplendor: We ſtill ſee there, nevertheleſs, temples, towers, and a very beautiful bridge of white marble, not to mention the columns and other monuments of antiquity brought thither from Greece. The cathedral, an immenſe building, is caſed with the ſame marble. There is no other material in a chapel called St. Epina's [or the Holy Thorn] built alone out of the ſavings of a beggar. The round tower, near the cathedral, is of the moſt beautiful marble of Carrara. This tower, which is ornamented with ſeven rows of pillars, without counting that of the turret, was built near ſix hundred years ago. It is about four toiſes in diameter, and is particularly famous for its inclination, which makes it look at firſt ſight as if it threatened ruin. Some have pretended, that it was built out of deſign with this apparent defect. This ridiculous conjecture, adopted by Martiniere's dictionary, is confuted by the ſlighteſt attention. All the lintels of the doors are ſhattered; the bearings of the ſtone are not horizontal; the greateſt part of all the ancient towers in Piſa incline in the like direction; ſeveral of the uprights and ſpurs of the cathedral lean the ſame way; which proves that the ground-plat of theſe edifices being built before the uſe of foundations upon piles, it has verged towards the South, which is on the ſide towards the river.

An evident proof that the ground of Piſa is not ſolid is, that the obſervatory of that city, a very beautiful building, erected about ten years ago, on the foundations of an ancient tower, ſunk in the month of March 1755 upwards of a Paris foot. This is what M. Perelli, then director of that obſervatory, aſſured himſelf of.

I meaſured with a line and plummet the height and inclination of the tower of Piſa: The defect of its level is about thirteen feet, Paris meaſure, counting from the foot of the baluſtrade placed on the platform, to the foot of the cupola or little turret on the top, in which are the bells. I found the height of the ſaid platform above the level of the place, or ſuperficies of the ground on which the cathedral ſtood, to be a hundred and thirty-three feet; to which adding about twenty-ſeven feet more for the height of the turret [which leans more than the body of the tower], eight feet for the depth of the trench, and about two feet, which the line meaſured ſince the operation, uncharged with any weight, would have appeared ſhorter; we ſhall have for the total height of the tower a hundred and ſeventy feet, on the ſide where it inclines moſt; inſomuch, that were it ſet upright again it would be within a very little of a hundred and ſeventy-two feet high * This

height

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* A remarkable curioſity of this kind, though, like moſt other Engliſh curioſities, little known or regarded, is to be ſeen in Caerphilly-caſtle in Glamorganſhire, in South Wales. Amidſt the many other tremendous pieces which compoſe that vaſt pile of ruins, is a large tower, nearly towards the Eaſt end, which every moment threatens deſtruction to the unwary paſſenger. Its height is not by a great deal ſo much as that of Piſa, being not above ſeventy or eighty feet, at moſt; but from the top down almoſt to the middle runs a large fiſſure, by

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height is not the half of that of the tower of Aſinelli at Bologna. The latter is only of brick; its form ſquare; but its baſe appears much ſtraighter than that of the tower of Piſa. They give to the tower of Aſinelli three hundred and ſeventy-one Rhinland feet, which make near three hundred and fifty-eight of ours. The towers of the church of Notre Dame at Paris are no more than two hundred and four. Another tower at Bologna, called the Gariſſenda, of the ſame materials, the ſame form, and the ſame diameter, ſeemingly, as the tower of Aſinelli, appears to the eye to lean no leſs than the tower of Piſa; but the upper part of the Gariſenda is tumbled down, or has been demoliſhed, in order to prevent its fall.

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which the tower is divided into two ſeparate parts, ſo that each ſide hangs over its baſe, in ſuch a manner that it is difficult to ſay which is moſt likely to fall firſt. According to the opinion of the ingenious Mr. Wood of Bath, who lay upon his back for ſeveral minutes to view this dreadful ruin, its lineal projection, on the outer ſide, is not leſs than ten feet and a half. What renders it ſtill the more remarkable is, that it has continued to project in this manner for many ages paſt; nor have we the leaſt account given us, either from hiſtory or tradition, how it firſt happened.

It is on the bridge of marble, which I have ſpoke of above, that they exhibit at Piſa every three years a ſingular feſtival, of which I was a witneſs. Its origin is loſt in the remoteneſs of antiquity *. Six hundred and forty champions, divided into two troops, armed with cuiraſſes and gilt helmets, diſpute with each other the bridge with heavy blows of clubs; frequently they hurl one another into the river, where there are boats ready to receive and ſuccour them: The carnage of the combatants ſometimes renders this ſpectacle tragical. It could only furniſh me with chirurgical obſervations, which I have not made a part of my collection.

I returned from Piſa to Florence, where every thing invites a paſſenger to prolong his ſtay; and where, overwhelmed with the marks of attention and favours of the Corſini family, I occupied the largeſt and moſt beautiful palace of the city, in the abſence of its maſters, who, ever ſince the pontificate of Clement XII. make their ordinary reſidence at Rome.

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* See the Book entitled *Oplomachia Piſana,* publiſhed in quarto, at Lucca, in 1713.

On tranſporting to Vienna the cabinet of natural hiſtory purchaſed by the emperor at Florence, that prince left in this city a prodigious number of vaſes, jewels, and works of art, both ancient and modern, compoſed of the moſt valuable materials and ſet in the richeſt workmanſhip, which made and ſtill make a part of the immenſe collection of antiquities and curioſities of the gallery of the palace of Medicis, where this kind of curioſities alone takes up ſeveral very large armories. A deſcription of this gallery has been long promiſed to the publick. The chapel of St. Laurence, deſtined for the ſepulture of the princes of the houſe of Medicis, into which the moſt precious marbles are ſcarce admitted, includes within its ſhell, which is not yet finiſhed, the richeſt and moſt magnificent aſſemblage of large pieces of jaſper, porphyry, lapis lazuli, &c. which are ſeen only in ſmall ſolitary fragments in the richeſt cabinets of Europe.

We know, that it is with ſmall priſms or cubes of theſe hard ſtones, artificially fixed in a cement prepared for the purpoſe, that the ancients delineated the ornaments of flowers, animals, and even human figures, in colours that are unalterable, which they called Opus teſſellatum, or Muſivum, and we Moſaick*. One of the moſt beautiful monuments in this kind, among thoſe which are not already publiſhed, is a pavement above ground, found at Fraſcati, in a houſe belonging to the Jeſuits, called Rufinella, which, it is pretended, made a part of Cicero's Tuſculum. We ſee there a buſt of Minerva, armed with a caſque and cuiraſs, much larger than nature, and executed in the grandeſt manner. Chymiſtry, in giving to glaſs colours no leſs durable, oftentimes more lively than thoſe of the hard ſtones, together with all ſorts of ſhades, has put the artiſts of the middle age in a condition to bring this beautiful art to perfection †. It is at Rome that it is cultivated with the greateſt ſucceſs, eſpecially for upwards of a century paſt; owing to the immenſe number of works carried on in the church of St. Peter. All the vaults of it are, or will very ſhortly be, covered with performances of this kind; the ſeveral tables of the altars in the chapels will be executed in the ſame manner: It is thus that they have found out the means of rendering a portrait as durable as a ſtatue, and of eterniſing thoſe maſterpieces of painting, which two or three ages would have ſufficed to deſtroy.

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* See the treatiſe of M. now Cardinal, Furietti, concerning Moſaicks, publiſhed at Rome in quarto, 1752.

† In many of the old Moſaicks, we ſometimes find, eſpecially on the borders, pieces of coloured glaſs; but if we may ſuppoſe that this is a reparation, leſs antient than the work, we may at leaſt remark that theſe pieces have not all the ſhades in them which the modern Moſaicks have, and that they only form therein

They have endeavoured to improve upon the moſaick of the hard ſtones, by ſubſtituting in its ſtead a ſpecies of pinked or inlaid work of the ſame materials. This inlaid work is not compoſed of ſmall priſmatical or cubical pieces, proportioned to each other, ſuch as are made uſe of in the common moſaick; the new incruſtation is formed of large unequal pieces, cut as the contour of the objects to be repreſented requires. At firſt they confined it to the

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therein compartments of glaring colours. The materials of the antique Moſaicks, which repreſent human figures, or other animals, are of marble, brick, or clouded flints, of various colours.

repreſentation of flowers and fruits in their natural colours, ſometimes of birds and inſects, delineated by proportionate pieces of agate, jaſper, lapis lazuli, cornelian, and coloured flints. We have in France, in ſome of the royal houſes, and in ſome great noblemens ſeats, beautiful pictures made in this manner in the laſt century: but in the modern works at Florence, Rome, and Naples, they have attempted to introduce human figures.

This kind of work has two advantages over the moſaick. They ſave hereby that great number of joints and angles which are unavoidable in the aſſemblage of ſmall priſms, of which moſaick is compoſed; but what they gain thereby in the correctneſs of the deſign, which the piece traced out follows exactly in the contours, and in the beauty of the colours, which is not tarniſhed by the joints, they loſe in the degradation of the tints, which the variety of ſhades in the ſmall cubes of the moſaick renders much ſuperior to thoſe in the large pieces. In the more recent pictures, where they have introduced human figures, this difference is yet more perceptible. A ſtone cut on the very contour of the figure, gives a neater draught, and the deſign, viewed near at hand, is more exact; but the fleſhy parts, and the draperies formed by the large pieces expreſſive of them, have no demi-tints, and reſemble rather inlaid works that are coloured: The pictures of this kind even of pure architecture, though ſeducing at the firſt glance of the eye, are not exempt from this defect.

The meridian of St. Petrona's, traced at Bologna above a century ago, by the illuſtrious Dominick Caſſini, is well known throughout all Europe: but it is in general very little known, that the greateſt of all the monuments in this kind, has exiſted for upwards of theſe three centuries paſt in the cathedral church of Florence, and that Paul Toſcanelli was the author of it.

During my abode in that city, I examined with father Ximenes the jeſuit*, profeſſor of mathematicks, and now geographer to his imperial majeſty, the ſeveral parts of this ancient meridian, at that time bu-

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* This memoir was read in 1757.

ried in the moſt profound oblivion*. The great ſolidity of the braſs plate, deſtined to ſerve as a centre to the dial pin, which is ſeven lines thick enchaſed and ſealed in the cornice of the lantern, which crowns the dome, and ſupported by two ſtrong brackets alſo of braſs, pierced with the moſt careful attention by a conical opening en bizeau: the projecting part of the ſtone [in which this plate is fixed] being beaten down, and the border of it made hollow, that the whole plate might be always illuminated by the ſun at noon; its height of upwards of two hundred and ſeventy ſeven feet, Paris meaſure, above the pavement of the church; the diameter of the hole, which is leſs than the two thouſandth part of its height; the circular marble fixed in the pavement of the church, in order to receive the projection of the ſun's ſhadow in the ſummer ſolſtice; the obſervation made on this marble in 1510, atteſted by an inſcription which is ſtill legible: all theſe circumſtances denote the capacity and great views of the author of this work. I regretted that ſo beautiful a monument of modern aſtronomy, raiſed in an age when the arts and ſciences had not yet triumphed over barbariſm, ſhould continue in obſcurity, and that it ſhould remain without uſe in an age ſo enlightened as ours. I made thereupon ſome repreſentations to the count de Richecourt, preſident of the council of regency of Tuſcany. He ſeemed to me to pay great attention to them. In ſhort, I learned ſome little time after, at Rome, that his imperial majeſty, being informed by that miniſter of the importance and utility of the meridian in the cathedral of Florence to the progreſs of aſtronomy, had ſignified it as his pleaſure that nothing ſhould be wanting to its reſtoration. Father Ximenes, being charged with the execution of the emperor's orders, has ſince rectified with a ſcrupulous exactneſs all the parts of the ancient dial; has traced and repaired the meridional line, has reeſtabliſhed its level, has made new ſolſtitial obſervations, and has concluded, in ſhort, by a compariſon of them with the antient ones, that the obliquity of the ecliptick was leſs by a minute and ſixteen ſeconds in 1755, than in 1510. He gives an account of all his labours in a work in 4to, which is now beneath the preſs*. In 1756, I received at Rome a manuſcript ſheet from him, containing his firſt obſervations, which he requeſted me to communicate to the academy: I fulfilled his deſire, and the academy have admitted him into the number of their correſpondents.

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* See page 41, of the hiſtorical introduction to the work, cited in the following note.

All the dimenſions of the new meridian were taken in toiſes, feet, inches, and lines of Paris. The French meaſure and that of Florence, engraved on braſs, are incruſted in the pavement of the church, exactly under the centre of the dial. They were regulated by the demi-toiſe of iron which I carried into Italy; and the latter had for its ſtandard† the toiſe which M.

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* This work has appeared ſince the reading of this memoir, under the title of *Vecchio e nuovo Gnomone Florentino*, *Florence*, 1757. i. e. The old and new dial of Florence, publiſhed in that city in 1757.

† I ſuppoſe at that time, with M. de Mairan, (ſee Memoirs of the Academy of Sciences, in 1735 p. 157; and 1747, p. 499 and 500) that the toiſe was equal to the iron rule which M. Godin, M. Boguer, and myſelf, carried to Peru in 1735, to ſerve us in the menſuration of the terreſtrial degrees, and

de Mairan made uſe of in his experiments of the pendulum.

I left in like manner at Rome the length of the ſame toiſe on the entablature of a ſtone balcony in the facade of the palace belonging to the academy of painting, ſculpture and architecture in France. The iron toiſe ſent by M. de Mairan to the fathers Maire and Boſcovick, jeſuits, in order to ſerve them in their menſuration of a degree in the eccleſiaſtical ſtate, is exactly compriſed [when M. Reaumur's thermometer points at 1014] between the two vertical faces and parallels of the two notches made by a rule in the cylinders of porphyry fixed in the entablature of that balcony, with a projection of half an inch, which forms a ſtandard proper for cutting another

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and of which I left a model with the academy. This model and our toiſe had been compared and found to be equal in one of our aſſemblies. The year following, that is to ſay, in 1736, the model propoſed was carried by M. de Maupertuis and his collegues into Lapland, where it ſerved them in their menſuration of a degree of the meridian, interſecting the polar circle. But the toiſe of M. de Mairan has been ſince diſcovered to be ſhorter than ours by about the tenth or twelfth part of a line; ſome allowance being made for a more accurate examination.

another rule, whether of wood or metal, of the exact length of a toiſe. If we would take the ſame meaſure with a pair of compaſſes, inſtead of carrying their points on the projecting parts of the two notches, which is as difficult as it is inconvenient, we ought to make them correſpond with two very fine parallel lines, traced with a diamond, on the horizontal ſurface of two porphyry cylinders, in the prolongation of the inſcribed ray.

It is only in the preſent century, and even within theſe thirty years, that on account of ſome new experiments regarding the length of a pendulum for ſeconds and the new menſurations of the terreſtrial degrees, undertaken by this academy, we have perceived the neceſſity of carrying our preceſſion to the moſt ſcrupulous exactneſs, in the making out of inſtruments that are intended for meaſuring, and it is true alſo that it is only in ſuch caſes we have need of ſo great a preciſion. The models of the ancient meaſures were divided only into digits, without any leſſer ſubdiviſion. What is this in effect, but a line more or leſs in a fathom or an ell, deſtined to meaſure the length of a wall or piece of ſtuff. They very much neglect inches in common ſurveying, and likewiſe in maſonry. There would be nothing aſtoniſhing then at all in it, though there ſhould remain an uncertainty of a line or more with reſpect to the length of an antient meaſure ſuch as that of the cubit, or of the Greek and Roman foot: the latter is particularly the ſubject of our preſent enquiry. We have no true model left us of it; and though we had, could we be certain that the length of the Roman foot was not changed at different times? Were the meaſures of the ancients ſecure from thoſe accidental variations, which the more uſual ones among the moderns, ſuch as the toiſe and ell, are liable to? They found themſelves under a neceſſity of reforming the firſt in 1668, and of ſhortening it by five lines. We are ignorant whence this error proceeded; and what is perhaps ſtill more ſingular, we are able to find no other veſtige of this reformation of five lines, than a bare mention of the fact, in a ſhort treatiſe de menſuris of M. Picard, tom. VI. of the antient memoirs of the academy *, and a word or two more

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* Page 536.

more in the menſuration of a degree by the ſame author. All thoſe who have ever mentioned it ſince, have done nothing more than quote this academician. It is true that we ſaw at Paris, about two years ago, an old ſtandard of iron, defective and erroneous, fixed in a ſtone pillar, in the angle next to the ſtair-caſe of the great chatelet, and that we even ſtill ſee there a ſtandard of the new toiſe, alſo of iron, and fixed in the interior pillar of the arcade, by which we aſcend to the ſaid ſtaircaſe. It has not yet been ſtolen *, as the old one was; but what would ſcarce be believed out of France, no inſcription has ever been ſet up to tell us either what one or the other is, nor wherefore, or at what time, they were placed there. Beſides, that which now remains there, in this reſpect like the old one, which no longer exiſts, is ſo rudely made, the angles of the two ends or points which terminate this ſtandard are ſo very much worn, whether by the frequent uſe made of it, or the injuries of the air, or any other accident, that two toiſes meaſured upon this model, though by the ſame perſon, would not be found equal, unleſs it were

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* So ſaid in 1762.

ere by very great chance*. Since the eformation made under the inſpection of I. Picard, whoſe name alone is ſufficient o make us preſume upon the greateſt accuracy, we find he was himſelf miſtaken n near ſix toiſes, with reſpect to the very undamental baſis of his labour for the menſuration of a degree; and his error is a roof that the toiſe he made uſe of for meaſuring his baſe was too ſhort by near a ine†.

M. de la Hire has found the ell of Paris o very different among the ſeveral bodies of tradeſmen, that ſome of them make it, as he ſays, four lines ſhorter than others§.

The ell eſtabliſhed by the edict of 1557, was fixed at three feet, ſeven inches, eight lines;

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[*] See the new project of an univerſal meaſure, publiſhed in the Memoirs of the Academy of Sciences, for the year 1747, p. 500.

[†] This error, which was found out in 1740, has been ſince verified in 1757, by the new meaſurements of the commiſſaries of the academy. See the meridian of Paris verified, ſect. I. Art. I. p. 33. and following. Menſuration of three degrees of the meridian, p. 252. and following. Memoirs of the Academy for 1754, to p. 185.

[§] Memoirs of the Academy for the year 1714, p. 398.

lines; yet the iron ſtandard of this meaſure, kept ſince the year 1554 in the merchants hall, was but three feet ſeven inches and near eleven lines of the reformed toiſe made in 1668. This point was not cleared up till 1745, on the examination and proof made of it by Meſſ. Camus and Hellot, of this academy, authoriſed by the miniſtry*. They moreover found this ſtandard very rudely made, and ſtill worſe divided, by reaſon of its large, unequal and crooked ſtrokes, and in ſhort too long by more than a third of a line, at the entry of the two projections made for embracing ſuch meaſures as ſhould be preſented there for trial.

After what I have juſt obſerved, ſhall we be at all ſurpriſed, that amidſt the antient feet, preſerved at Rome, there ſhould be any found, which differ from each other by more than a line? It is now near a century ago ſince Meſſ. Picard and Auzout gave in their proportion of a Roman foot to that of Paris, that is to ſay, ſuch as they concluded it to be; the one from a compariſon of ſeveral teſtimonies, the other from his own obſervations made upon ſome ntique ſculptured feet. Since that time they have diſcovered at Rome ſeveral others, as well ſculptured as of metal. Theſe are all different from one another, and have been differently rated for three centuries paſt by the learned, by curious travellers, and by antiquaries. In doing this, the greater part of them employed their own national meaſures, the proportions of which to ours are not perfectly ſettled*, and each of them likewiſe made uſe of a foot, the authenticity of which has been tried and proved by none of them. On one ſide the ſeveral models differ ſometimes a line or more ; on the other, the ſeveral obſervers agree not ſometimes by nearly two or three lines with reſpect to the length of the very ſame foot †.

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* See Memoirs of the Academy for the year 1746 page 607, and following.

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* Memoirs of the Academy for 1747, p. 498.

† Ebutius's foot, according to Fabretti, contains $133\frac{1}{3}$ ; lines ; according to father Revillas, $131\frac{1}{2}$ ; according to the Abbe Barthelemi, and father Jacquier, in 1756, $130\frac{2}{3}$, being near three lines leſs than what it is made by Fabretti. The ſame gentleman found the feet of Statilius and Coſſutius equal ; M. de la Hire thinks they vary by near half a line. See the Diſſertation of the Academy of Cortona, tom. III. p. 125 ; and Memoirs of the Academy of Sciences, 1714, p. 395 ; and Memoirs of the Academy of Belles Letters, tom. XXVIII. p. 609.

I ſhould have as much right as another to report here my own particular meaſure of the ſeveral ancient feet that are known, and to draw from thence a new determination of the length of a Roman foot, but that I have not the preſumption to think it at all better than any of the foregoing, and that it would ſerve perhaps only to multiply doubts. I thought my time would be better employed, if I ſhould be able to remove to Paris the originals themſelves, or, in default of them, their models en creux; which I cauſed to be made on the four antient Roman feet preſerved in the Capitol, viz. thoſe of Statilius, Coſſutius, and Ebutius, and that which has been ſince found near the Villa Corſini, and preſented to the cabinet of the Capitol by the marquis Capponi, whoſe name it has retained. I ſpeak not of thoſe portable feet of iron or braſs, which ruſt, verdigriſe, and even uſe alone may have rendered too ſhort. The queſtion here is only concerning feet that are found ſculptured in bas relief. I took care to let the plaſter dry on the original reliefs, that the models in drying might preſerve, if poſſible, their juſt length*. I have depoſited theſe moulds, ſince the reading of this memoir, in the King's cabinet of medals, under the care of the Abbe Barthelemi. Thus we may for the future at Paris, as well as at Rome, examine and compare theſe four meaſures one with the other, and draw the ſame inferences from them, as if we had the very originals, ſuch as they now are, before our eyes. That is to ſay, on the inſpection alone, and ſtill more upon the tryal, any perſon may be convinced as I am, 1ſt. That the ſculpture of theſe feet, whether upon ſtone†, or upon marble, has never been delicate enough, even before the projecting parts of the relief of the angles were impaired and worn down by age, to have enabled us, at any period, to regard theſe monuments as faithful ſtandards of the ancient

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[*] It were to be wiſhed that in caſes like this, we could employ for the mould a matter as proper as plaſter for receiving the impreſſion, but more ſolid, and capable of acquiring, at leaſt for a time, a greater degree of hardneſs. Such a compoſition would not be impoſſible perhaps to be found, and would merit the reſearches of any lover of the arts, more dexterous and fortunate than I can pretend to be.

[†] The foot called Ebutius's, is not carved on marble, but on a ſtone called *Peperino*, which is more porous, and by a great deal leſs fine, than marble.

cient foot: and in fact, whatever appearance a ſculptor, or rather a ſtone-cutter, charged to carve in a rough manner a ſepulchral monument may have pretended, or even been able religiouſly to give to the juſt length of a Roman foot, in the repreſentation of a ſymbol, deſtined only to point out the profeſſion of the architect mentioned in the epitaph; That 2dly, by the ſtrongeſt reaſon in the ſtate of alteration, in which theſe pretended models of a Roman foot now are, it is not poſſible to perceive evidently what has been their primitive length. 3dly, That they are alſo viſibly unequal among themſelves, and thus that we cannot by means of them arrive at any more exact calculation of the Roman foot than is given of that of Paris, when we pretend to determine its length by thoſe broken feet of wood which our workmen commonly make uſe of, and which frequently differ among themſelves by more than half a line: furthermore on this ſuppoſition can they have more conformity with one another than the ſeveral antique feet in the Capitol, in which the very bizel alone may cauſe a much greater difference?

If any thing could ſeem proper to clear up the debate relative to the meaſures of the antients, it would be without doubt an old plan of a city, many of whoſe ancient edifices may ſtill exiſt, or at leaſt may be diſtinguiſhable in their veſtiges. In 1573, they found in the ruins of a temple of Romulus, which forms at preſent the church of St. Comus and St. Damien, at Rome, the ſhattered remains of a plan of that city, engraved on marble, about the time of the emperor Septimius Severus. Theſe fragments, which at firſt were collected with avidity, but afterwards neglected, have remained in oblivion for near two centuries in the palace of Farneſe; and it is only ſince the year 1742, that, thanks to the cares of the reigning pope (Benedict XIV.) who begged them of his Sicilian majeſty, what remained of them was removed to the Capitol, and divided into twenty ſix tables, which at preſent line the walls of the great ſtair-caſe.

At the ſight of this monument, to which they have annexed a ſcale of braſs, incruſted in the firſt table of the fragments, and deſigned to meaſure the diſtances of the plan, I con-

I conceived great hopes ; and my firſt care was to try the accuracy of the ſcale. The inſcription ſet upon it in 1742 imports, that this ſcale was drawn from a compariſon of the antient monuments, at preſent ſubſiſting: Tabulæ I. adjecta eſt compendiaria pedum antiq. Rom. LXXX. menſura, ex eorumdem fragmentorum collatione cum veteribus ædificiis deprompta : i. e. “ To the
“ firſt table is added a compendious ſcale
“ of 80 feet of the antient Roman mea-
“ ſure, drawn from a compariſon of the
“ ſaid fragments, with ſome old buildings.”
However, I found on the firſt trials, that this ſcale but ill agreed with the true meaſure of ſuch monuments as are moſt clearly deſcribed. The author of the inſcription, as well as thoſe who preſided over the reſtoration of the fragments, was dead*. After many enquiries, I at laſt found out the perſon who had made the ſcale of the plan. This was the ſieur Nolli, author of the beſt and largeſt plan we have of modern Rome, which was magnificently engraved in 1748. I learned from his own mouth what

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* Theſe are the marquis Capponi and father Revillas.

vhat means he made uſe of for formng this ſcale ; and I perceived, on a new xamination, the little dependence that was to be made on the conjectures by which he had been determined, and convinced him of it. Letting all other proofs hen reſt there, it is ſufficient to obſerve, hat the ſcale which he has annexed to the plan is equal to ſix inches and near two ines of our foot, and that it meaſures herein a diſtance of eighty ancient feet ; whence it would follow, that the whole plan, of which they have collected only ſome fragments, would be nearly a hundred feet diameter *, Paris meaſure, which is impoſſible, ſeeing that the total diameter of the temple of which this plan formed the pavement, and which I meaſured myſelf, is but forty-four feet eight inches. In ſhort, the more cloſely we examine the moſt perfect fragments of this ancient plan

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* Rome contains upwards of 3000 paces, or more than 15,000 ancient feet, from the Flaminian gate (now called del Popolo) to the Porta Capena (at preſent that of St. Sebaſtian), and 80 feet being $187\frac{1}{2}$ part of 15,000 feet, this diſtance of 15,000 feet would have been meaſured on the antique plan by a ſcale $187\frac{1}{2}$ long, which anſwers to upwards of 96 feet, Paris meaſure.

[I ſay the moſt perfect, for a great number of them having been either loſt or diſperſed ſince its firſt diſcovery, have been repaired after the engraving of Bellori, which comprehends only the leſſer part] the more we ſhall be convinced, that the inartificialneſs of the execution, and the little exactneſs of the work, render it abſolutely of no ſervice towards clearing up the debate relative to the ancient meaſures. I ſhall not enter into a detail of the different proofs which I might produce on this occaſion, and which alone would furniſh ſufficient matter for a memoir; I ſhall only add, that if I had had any doubt left, I ſhould have been confirmed in my opinion by that of the Abbe Barthelemi, whom his own particular reſearches, and the new obſervations which we made together at Rome, have led to the ſame concluſions as myſelf. Since my return into France, I have ſeen that this was alſo the opinion which M. Piraneſi delivered with regard to this antique plan, almoſt all the fragments of which he has engraved anew, in that great work of his which he has juſt publiſhed on the antiquities of the Romans, in four large volumes folio.

folio*. Nothing can conſole us better for the preſent ruinous ſtate of this monument, than the little real value it is of, and its unſerviceableneſs, which has been ſo well proved, towards adjuſting the meaſures of the ancients, even though it were entirely preſerved.

It is very probable, that the fundamental dimenſions of any large edifice, when they have not been confined by the ground, contain a round, or at leaſt an entire number of ſmall meaſures; that the two axes, for inſtance, of the ellipſis of the Colliſeum, that the diameter of the Pantheon, that the facade of the baths of Diocleſian and Caracalla, have rather an entire than a broken number of Roman feet. This reflection,

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* This antique plan is ſo defective in itſelf, that it is of leſs importance to obſerve here, that the engravings of Bellori are far from being exact, and that they ſeem as if made at ſight; the diſtances and number of columns in the temples and other edifices, the proportion of the lines, the opening of the angles in them, being frequently very little conformable to the original. I muſt ſay the ſame of the engravings of M. Piraneſi, which are viſibly copies, and even negligently done, of thoſe of Bellori; without doubt, becauſe M. Piraneſi judged that the time which it would require to execute them with greater exactneſs would be pure loſs.

flection, which naturally preſents itſelf, ſuggeſted to me a method which appeared to me proper for determining the true length of a Roman foot. With this view I took, as accurately as poſſible, ſome capital dimenſions of the moſt celebrated monuments at preſent exiſting in Rome, and I ſought which of the meaſures attributed to the Roman foot, divided the total length without any remainder; but this expedient, which has not even the merit of novelty *, did not ſucceed with me; for when all the inferences I propoſed drawing from it were made, I perceived that I ought not to expect any greater preciſion in it, than from the meaſure of one ſolitary foot taken ſeparately. This is what I believe has not been remarked before; but be that as it will, the following is a proof of its truth.

Firſt, this method is not exempt from difficulty. I ſuppoſe, that the interior diameter

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* See M. Picard's treatiſe *de menſuris*, already cited (*Ancient Memoirs of the Academy of Sciences, tom.* vi.) *Memoirs of the Academy for* 1714, *p.* 396, *&c.* I ſhall give, however, the reſult of my endeavours for this purpoſe, at the end of this memoir, and the ſeveral evaluations of an ancient Roman foot, which we may draw from them.

neter of the Pantheon, the area of which s circular, may be a hundred and fifty Roman feet. This it ought to be, according o all appearance, from the very firſt ſtratum of the ſtones of the foundation, that his diameter may have the ſaid round number of ancient feet, and not at the ſurface of the ground; and yet it is only on the ſurface that we can take our actual meaſure. Secondly, ſuppoſe it be granted, that this length ſhould be taken at the ſurface, yet ought it at leaſt to agree with the exterior, rather than the interior diameter of the walls of the temple; but it is the latter only that is acceſſible; the exterior can only be concluded upon by deducting the thickneſs of the walls; and this thickneſs can be meaſured only at the gate, where it is by no means the ſame as in the reſt of the contour. Thirdly, aſſiſted by M. Moreau, now architect to the city of Paris, I meaſured ſcrupulouſly at Rome, with a chain of iron equally extended on the pavement, four radii of the Pantheon, taken from the centre to the axis of four columns, oppoſed to each other, two and two. I proved at Paris theſe meaſures, which I

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had noted down on the ſame chain, and marked with a file. I employed in this verification the toiſe which had been made uſe of in the menſuration of a degree of the meridian beneath the equator, and the aſſiſtance of the Sieur Canivet, a maker of mathematical inſtruments. The difference between the two radii, taken from North-eaſt to South-weſt, is near four inches; but the total diameter is equal nearly within an inch to that which croſſed it at right angles; and one with another they are a hundred and thirty ſeven royal feet, and one or two inches. The celebrated Deſgodets has meaſured twelve of theſe radii with his uſual exactneſs. Among them are ſome that differ ſeven inches, which would make upwards of half a line difference in a Roman foot. The length of my diameter exceeds the medium diameter of this architect by no more than between four and five inches, adding to his three feet five inches for the radius of the two oppoſite columns, which is not compriſed in his meaſure. Fourthly, and laſtly, and this reaſon alone is deciſive, the longer meaſures have been determined only by the multiplication of the figure of which they are compoſed; that is to ſay, by the ſucceſſive application of this figure to the extent of the ground. A long meaſure, therefore, will not yield any greater preciſion than a ſmall one. If the architect, for inſtance, had wanted to give a diameter of a hundred and fifty Roman feet to the Pantheon, he would have meaſured them with his own foot rule, applied a hundred and fifty times to the ground, or, if you pleaſe, with a longer rule, ſuch as a fathom, or a toiſe. Now this meaſure, whatever it had been, could not have been divided but by a foot; and what proof have we that this foot would have been more exactly cut than the old feet in the Capitol, which differ among one another by more than a line? An error, therefore, proceeding from any little want of accuracy in the architect's foot, would have been multiplied a hundred and fifty times over in the total length of the diameter of the Pantheon. The ſame error might ſtill have been increaſed by any bungling operation in the repeated application of this foot, already defective in itſelf; and we muſt not imagine, that errors committed by applying any meaſure negligently to the ground, will within a little compenſate for each other: That only holds good when they are ſometimes more and ſometimes leſs; but an erroneous manner of proceeding, when it is uniform, muſt multiply the error of which it is the cauſe: Thus, for example, the application of a toiſe upon the ground, when we ſet it down or take it up, by laying it alternately on its oppoſite faces, neceſſarily makes us count too much to each length of it, by the thickneſs of the rule.

Theſe reflections are ſufficient to convince us, that we are not to expect any greater preciſion or uniformity in the determinations of a Roman foot, formed upon the geographical menſurations of an ancient mile. An evident proof alſo, that the toiſes of the ancients have been negligently meaſured, with feet neither exact nor equal among themſelves; and that, in ſhort, many errors have crept into them, may be drawn from the unequal diſtances of their military ſtones, which we yet find ſtanding on ſeveral old highways, as well n France as Italy, and from the various lengths of a Roman mile, which have been concluded upon from them. But ſhall we be aſtoniſhed at finding a few paces difference in the length of a mile, when we ſee ſeveral inches difference in columns of only three or four feet diameter, in the moſt beautiful ancient edifices?

As for the method employed by Villapandus, and ſome others, for deducing the length of a Roman foot from the capacity of the Congius, or any other hollow meaſure, it is ſtill more ſuſceptible of error than all the preceding ones, on account of the multitude of figures that enter into this determination. The concluſions alſo which have been drawn this way, are ſuch as carry us ſtill farther from the medium given by other calculations.

After all the learned reſearches which have been made for three centuries paſt on the Roman foot, it appears that the ſubject is now quite exhauſted, and that we cannot hope for any thing more than an approximation to it, which leaves at leaſt an uncertainty of half a line. To ſpeak only of the calculations of the moderns,

M. d'Anville, in his treatiſe of itinerary meaſures publiſhed in 1741, after weighing all the teſtimonies that had fallen beneath his notice, fixes the Roman foot at 10 inches, 10 lines, and $\frac{6}{10}$, or 130 lines $\frac{6}{10}$ of the Paris foot. Father Revillas, in a learned diſſertation on the Roman foot, inſerted in the Memoirs of the Academy of Cortona, printed at Rome in 1751 *, taking a medium between the different calculations of an ancient foot, drawn from the ſeveral feet now ſubſiſting, as well in marble as in metal, and the geographical meaſures, gives it two tenths of a line more than M. d'Anville, or 130 lines $\frac{8}{10}$. M. Freret, in a poſthumous diſſertation, printed in 1756, gives the preference to Statilius's foot †, which he looks upon as the medium between all the different ancient feet; and he ſuppoſes this foot to be 131 lines $\frac{8}{10}$. Father Boſcovick, in his menſuration of a degree of the meridian, printed at Rome in 1755, adopted the opinion of M. Stuart, in his diſſertation on the obeliſk lately taken up in the field of Mars, and gives

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* Tome iii. p. 122.

† Memoirs of the Academy of Belles-Lettres, tom. xxiv. p. 490.

ives to the Roman foot 131 lines complete, r 10 inches 11 lines of our foot. This is he medium between the two foregoing alculations of Father Revillas and M. Freret. The Abbe Barthelemi and Father Jacquier, in 1756, ſince my departure from Rome, have meaſured the four ſculptured feet, and likewiſe one of metal; three of which they find equal to 130 lines $\frac{6}{10}$, and this is the length they allow to a Roman foot. Hitherto the ſeveral meaſures agree nearly to within half a line, and their medium ſcarce varies from the meaſure of an ancient foot, which Luca Petto, a celebrated Roman lawyer, cauſed to be engraved, by authority of the government, about three centuries ago, on a marble which is preſerved in the Capitol; a meaſure which may be eſtimated at 130 lines $\frac{3}{4}$. But Meſſ. Hellot and Camus having fixed the ell of Paris* at 43 inches, 10 lines, $\frac{4}{5}$, or $\frac{5}{6}$, agreeably to the reſearches which they made concerning it in 1745, on an old ſtandard belonging to the Mercers company, of the year 1554, they have found out that the Roman foot, which we have ſtrong reaſons to take for the fourth part of our ell, ſhould be 10 inches, 11 lines, $\frac{7}{10}$ or 131 $\frac{7}{10}$ lines of the Paris foot. Laſtly, M. de la Hire, in the memoir already cited, makes the Roman foot ſtill longer, and equal to 11 of our inches, or 132 lines. We cannot deny but theſe authorities are of very great weight; however, as M. de la Hire reaſons only on the meaſures taken by others, and his determination differs widely from all the preceding ones, this deciſion ought not to carry it over the multitude of contrary teſtimonies. As to the calculation of Meſſ. Hellot and Camus, it is founded on two ſuppoſitions, that are very controvertible: One that the ſtandard of the ell of 1554, which is inartificially and unequally divided, ſhould be a faithful copy of the older ſtandard, which had been preſerved without variation ſince the days of Charlemagne; the other, that the ancient Roman foot ſhould not have undergone any alteration when this emperor fixed the meaſures at the beginning of the ninth century. All theſe things being well conſidered, it appears that by making the ancient Roman foot to conſiſt of one hundred and thirty-one lines, that is to ſay, of ten inches eleven lines of our royal meaſure, or perhaps a little leſs, we ſhall not be very remote from the truth, and that we ſhall retain nearly, within a very little, the medium between the ſeveral ſlight variations to which we may ſuſpect the Roman foot has been ſubject.

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*Memoirs of the Academy of Sciences for the year 1746, p. 617.

I have brought from Rome the actual meaſure of the two columns of Trajan and Antoninus, as alſo of the facade of the Pantheon and ſome others, taken with as much preciſion as if theſe monuments had even been tranſported to Paris. I mean here by the words actual meaſure, a length equal to the thing meaſured; leaving it to any one who ſhall think proper to take the trouble, to determine the number of feet and inches contained in this length. The following is the method I obſerved in taking it:

I let an iron chain charged with two or three pounds weight of lead, in form of a ſounding plummet, hang down from the platform of the chapiter of the pillar, till the lead ſo fixed to the chain reſted on the pedeſtal of the pillar; then I marked with a ſtroke of a file the part of the chain which anſwered to the level of the chapiter; the other dimenſions are in like manner ſet down on the chain. By letting it hang at freedom charged with the ſame weight, we ſhall find the ſame length preciſely, when the thermometer points to the ſame degree, as I obſerved it did then at Rome, that is to ſay, eleven degrees beneath the point of congelation. We may transfer theſe meaſures to a wall, and even trace out on it horizontally, and within the reach of the eye, the profiles of theſe columns with their ſeveral dimenſions, and of courſe put it in the power of all curious perſons to ſatisfy themſelves in taking the height of them, more commodiouſly than they could even on the original itſelf.

The Campagna of Rome, formerly ſo well peopled and filled with delightful places, is at preſent deſert, and the air there reputed pernicious. We ſcarce meet now with a few villages, or hamlets, in an extent of ground which once contained twenty-five cities or towns; I ſpeak of the country inhabited by the Volſci, of which Velitræ, now Velletri, was the capital. It is the ſame with all the environs of Rome: they are uninhabited, eſpecially during the hot months, excepting a few elevated places, ſuch as Tivoli, Fraſcati, Albano, &c.

I endeavoured to inform myſelf with reſpect to an opinion ſo generally propagated, of the pretended mortal danger of expoſing one's ſelf to the air of the Campagna of Rome in the hot weather; and I am convinced that this danger is not greater than that which we run in every other country that is moiſt and marſhy. What they alledge for the moſt part concerning the air of Rome and its environs, is very little more than an old prejudice; very juſt indeed in its principles, but which it is time to reſtrain within its proper bounds, by examining its original and foundation.

It was after the invaſion of the Goths in the fifth and ſixth century, that this corruption of the air began to manifeſt itſelf. The bed of the Tiber being covered by the accumulated ruins of the edifices of ancient Rome, could not but raiſe itſelf conſiderably. But what permits us not to doubt of this fact is, that the ancient and well preſerved pavement of the Pantheon and its portico, is overflowed every winter; that the water even riſes there ſometimes to the height of eight or ten feet; and that it is not poſſible to ſuppoſe that the ancient Romans ſhould have built a temple in a place ſo low as to be covered with the waters of the Tiber on the leaſt inundation. It is evident then that the level of the bed of this river is raiſed ſeveral feet; which could not have happened without forming there a kind of dikes or bars. The choaking up of its canal neceſſarily occaſioned the overflow and reflux of its waters, in ſuch places as till then had not been ſubject to inundations: to theſe overflowings of the Tiber were added all the waters that eſcaped out of the ancient aqueducts, the ruins of which are ſtill to be ſeen, and which were entirely broken and deſtroyed by Totila. What need therefore of any thing more to infect the air, in a hot climate, than the exhalations of ſuch a maſs of ſtagnating waters, deprived of any diſcharge, and become the eceptacle of a thouſand impurities, as well s the grave of ſeveral millions both of men nd animals? The evil could not but in-reaſe from the ſame cauſes, while Rome was expoſed to the incurſions and devaſta-ions of the Lombards, the Normans, and he Saracens, which laſted for ſeveral cen-uries. The air was become ſo infectious here at the beginning of the thirteenth century, that pope Innocent III. wrote that few people at Rome arrived to the age of forty years, and that nothing was more uncommon there than to ſee a perſon of ſixty. A very ſhort time after the popes transferred the ſeat of their reſidence to Avignon: during the ſeventy-two years they remained there, Rome became a deſert, the monaſteries in it were converted into ſtables; and Gregory XI on his return to Rome, in 1376, hardly counted there thirty thouſand inhabitants. At his death, began the troubles of the great ſchiſm in the weſt, which continued for upwards of fifty years. Martin V. in whom this ſchiſm ended in the year 1429, and his firſt ſucceſſors, were able to make but feeble efforts againſt ſo inveterate an evil. It was not till the beginning of the ſixteenth century that Leo X. under whom Rome began to reſume her wonted ſplendor, gave himſelf ſome trouble about re-eſtabliſhing the ſalubrity of the air; but the city being ſhortly after beſieged twice ſucceſſively by the emperor Charles the Fifth, ſaw itſelf plunged again into all its old calamities; and from eighty-five thouſand inhabitants, which it contained under Leo X it was reduced under Clement VIII. to thirty-two thouſand. In ſhort, it is only ſince the time of Pius V. and Sextus V. at the end of the ſixteenth century, that the popes have conſtantly employed the neceſſary methods for purifying the air of Rome and its environs, by procuring proper diſcharges for the waters, drying up the humid and marſhy grounds, and covering the banks of the Tiber, and other places reputed uninhabitable, with ſuperb edifices. Since that time a perſon may dwell at Rome, and go in or out of it at all ſeaſons of the year. At the beginning, however, of the preſent century, they were ſtill afraid to lie out of the city in ſummer, when they had reſided there; as they were alſo to return to it, when once they had quitted it. They never ventured to ſleep at Rome, even in broad day, in any other houſe than their own *. They are greatly relaxed at preſent from theſe antient ſcruples: I have ſeen cardinals, in the months of July and Auguſt, go from Rome to lie at Fraſcati, Tivoli, Albano, &c and return the next or the following days to the city, without any detriment to their health: I have myſelf tried all theſe experiments, without ſuffering the leaſt inconvenience from them: we have even ſeen in the laſt war in Italy, two armies encamped under the walls of Rome, at the time when the heats were moſt violent. Yet notwithſtanding all this, the greater part of the country people dare not ſtill venture to lie during that ſeaſon of the year, nor even as much as ſleep in a carriage, in any part of the territory comprehended under the name of the Campagna of Rome.

M. Lanciſi and M. Leprotti, phyſicians to the Popes Clement XI. and XII. as well

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* They cannot at Rome compel a tenant to diſlodge in ſummer, even on default of payment.

as M. Lapi *, have ſtrenuouſly combated, both by reaſon and experience, the abuſe of this old prejudice, but it is only by inſenſible degrees that the truth begins to prevail. It muſt alſo be confeſſed that the experiments made for proving an air that is reputed mortal not to be ſo, are nececeſſarily very few, and no leſs foreign from the end propoſed.

I haſtened to paſs from Rome to Naples before the great heats ſhould come on : I arrived there too late to be a witneſs of the eruption of Mount Veſuvius. The firſt object then of my curioſity was the ſubterranean city of Herculaneum, buried beneath the aſhes of that Volcano, now for near ſeventeen centuries, and diſcovered at the beginning of the laſt, but on which the attention of the public has not been fixed till within theſe few years.

The moſt valuable beyond doubt of all the monuments which are admired there, is the

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* See *Joan. Mariæ Lanciſi Diſſertatio*, &c, or the Diſſertation of Joanna Maria Lanciſi, concerning the natural and adventitious qualities of the Roman climate,

he great number of manuſcripts on Egyptian paper, blackened and almoſt calcined, and nearly in the ſame ſtate as if drawn out of an oven. They have found out, however, the art of unrolling them, and of gluing the leaves on a very thin pellicle; happily they are written but on one ſide. They are now labouring to tranſcribe theſe manuſcripts, which it requires only time to do: They will, no doubt, hereafter ſucceed ſo far as to interpret them; they are all Greek. The characters of thoſe I have ſeen are very diſtinct; I have read, without difficulty, many words in them, and even entire lines.

Next to the manuſcripts, the thing that ſtruck me moſt, was the great number and variety of houſehold utenſils and little family moveables, many of which reſemble ours: and it is neceſſary to remark here, that hardly any, but thoſe made of metal have been able to laſt ſo long. I ſaw, among other things of this kind, ſilver diſhes emboſſed,

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mate, publiſhed at Rome in 1711; and the *Ragionomento contra la volgare opinione*, &c. *da Giovani Girolamo Lapi. Romæ*, 1749.

boſſed, with their ſub-cups, in the form of our coffee-diſhes. But theſe things have already afforded matter to abundance of writings; and antiquities are not here my object. I ſhall confine myſelf therefore, to ſome reflections on the ſtate of certain mechanical arts among the ancients, and on their progreſs among us.

They have found antique drinking glaſſes, ſeveral of which are of different forms, together with bottles; which alone would prove, that the ancients knew how to found and blow glaſs, and even that they had a ſort white enough to make window-panes of. One ſtep farther, and they had diſcovered, as well as we, the method of rendering blown-glaſs flat, and of making it into ſquares. Nor would they then have remained deſtitute of that greateſt of modern conveniencies, which we enjoy almoſt without perceiving it; viz, of thoſe windows and glaſs doors, which let in day-light to us, at the ſame time that they preſerve us from all the injuries of the air; which exhibit to us, even in the interior part of our houſes, the variegated view of nature; and which transform the winds, the froſts, the tempeſts, into a magnificent moving picture before our eyes.

The Romans, however, were ſtill far from the art of running glaſs, and making it into mirrours. There was a neceſſity firſt of bringing the matter and the method of fuſing it to ſuch perfection as that it ſhould imitate cryſtal; then to know how to plane and poliſh this purified glaſs, before they could think of fixing its tranſparency by a leaf of tin impregnated with mercury. It appears, that they had not even the art of tinning metals, though they knew extremely well how to apply gold and ſilver to them. In fact, the ſtatue and horſe of Marcus Aurelius at the capitol were gilt; a great number of family utenſils (let us dare to call things by their names) the very kitchen furniture found at Herculaneum, is frequently ſilver, but never tinned over. It is the reverſe with reſpect to ſolders; we find none among any pieces of antiquity in ſilver, but only in tin; and as this kind of ſolder is weak, we ſee nothing more of it than the ſhattered remains.

I muſt not forget the lace made of gold wire, found in this ſubterraneous city. I is of pure gold, and wove like cloth. They had not yet ſo much as ſet themſelves about thinking how to ſubſtitute inſtead of a gold thread a thread of ſilver gilt, which ſhould be as beautiful, lighter, and of a price greatly inferior to the other. For a very ſtrong reaſon, they had never taken any thought about ſparing again in the materials, without loſing any thing in the outward luſtre, by making flat the ſaid thread of ſilver gilt, and rolling it round a ſilken thread. The Romans were very far from foreſeeing that the time would come when an ounce of gold would be ſufficient to gild a thread of ſilver ſix leagues in length.

Among the great number of rings and precious ſtones ſet in ſignets, found at Herculaneum, I do not know that they have met with one diamond. Very few are ſeen that are antique; without doubt, becauſe they have been retailed upon us by the moderns, as faſt as they have diſcovered them. If ſome paſſages of Pliny and Iſidore give us reaſon to think that the anci-

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nts made uſe of the fragments of the diamond to engrave on hard ſtones, and to aſhion even the diamond itſelf, it does not ppear that they had made any great progreſs in the art of bringing the natural facets to perfection, of multiplying, and of poliſhing them with its own proper powder. I have ſeen no antique diamonds that had not their own genuine points, ſuch as they come out of the hands of nature, after having had the outward coat taken off. The coloured ſtones found at Herculaneum are mounted in gold, but very clumſily. I have ſeen there ſignets of Amethyſt, and among theſe ſtones, one of an oblong form, about ſixteen lines in length, very ſtraight, and cut en Goutte de Suif; as alſo emeralds, ſeveral of which were engraved, ſome en creux, others in relief, together with onyxes, cornelians, &c.

If we have any ſuperiority over the ancients in the practice of certain arts, it is not at leaſt in that of cutting and faſhioning theſe hard ſtones. I have ſeen with admiration little vaſes of rock cryſtal, the mouth of which is ſo narrow, that the inſide could not have been made hollow as it is, without much induſtry and patience; and I doubt whether, with greater advantages, our workmen would have ſucceded therein better. There cannot be any art of more antiquity than this. I ſaw in the cabinet of Baron Stoch, a celebrated antiquary at Florence, a cornelian fit for ſetting in a ſignet, on which were engraved the ſeven heroes of the antient Theban war, with their names in Greek characters. We know not at preſent any precious ſtone that is engraved, of a higher antiquity. It is believed to be of the time of the Trojan war; but the origin of this art is ſtill more ancient. It was common in Egypt before the going out of the Iſraelites, ſeeing they had among them lapidaries and engravers in fine ſtones: We find the proof of this in Exodus *.

In the publick monuments of antiquity, decency is ſeldom violated. It is not the ſame

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* "And thou ſhalt take two onyx-ſtones, and "grave on them the names of the children of Iſrael. " . . . . With the work of an engraver in ſtone, like " the engravings of a ſignet, ſhalt thou engrave, &c." Exod. chap. xxviii. v. 9. 11.

ſame with thoſe deſigned for the uſe of private perſons, and the interior decoration of their houſes. As the Pagan religion was no reſtraint to debauchery, the ornaments of painting, ſculpture, moulding, and carving, in the houſehold furniture of the antients, inſtead of that ſerіouſneſs and gravity which our veneration for antiquity leads us to ſeek for there, frequently preſent either obſcene objects, or the caprices of a wanton and trifling imagination. I happened to be preſent when they brought to the cabinet of antiquities at Portici a tripod of braſs, which had juſt been diſcovered, and which far exceeded all that had been found there before: It was as remarkable for the beauty of the work, as the impudence of three figures of ſatyrs, which ſupported the ſeat. I was at that time taken up in conſidering a monument of another kind, viz. a little limb of ſilver, weighing two or three ounces, on which was delineated a dial, or the horary lines; the numbers in it, which marked the hours, and the initial letters of the names of the months were diſtinctly engraved; the tail of the animal whoſe thigh was repreſented in the limb, ſerved as a pin to the dial. I had neither permiſſion nor opportunity to examine for what latitude this dial was made, which was ſo much the more difficult to determine exactly, as the ſmallneſs of the ray did not permit any great preciſion in the angles. We ſhall be the better able to judge of it when all the monuments found at Herculaneum, which are to be engraved and deſcribed, are publiſhed. The draughts for this purpoſe were very far advanced in 1755.

I ſhall add very little to the experiments made by the Abbe Nollet* on the vapour of the grotto del Cani near Naples. Emboldened by this attempt, I laid my face cloſe to the earth, and drew in at different times the vapour, which riſes there in a thick ſmoke from ſix to ſeven inches above the ſurface of the ground. A dog thrown into the grotto loſes the uſe of all his ſenſes in leſs than a minute. I felt as it were a ſmall ſmarting over the eyes; and on preſenting my tongue to it, an impreſſion ſomewhat piquant, without any diſtinct ſavour; I found alſo ſomething ſtrong in my throat—I dare not call it acrid, yet it had nearly the ſame effect as when we ſnuff up a weak volatile ſalt; but I perceived no ſmell in it. Finding myſelf at a loſs when I wanted to write down in my journal what effects I had experienced there, I returned the next day to the grotto, in order to examine the matter again. I went there even a third time, on the day following, accompanied by father de la Torre, a religious of the Sommaſcenes, and at preſent librarian to his Sardinian majeſty. I repeated the ſame experiments: I drew in the vapour thrice ſucceſſively, my noſe touching the ground, and felt the ſame ſenſations as the firſt time; that is to ſay, nothing very diſtinct as to the odour or taſte; but ſomething very penetrating and ſuffocating.

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* See Memoirs of the Academy of Sciences for the year 1752, p. 75, 76.

M. Reaumur's thermometer, with ſpirits of wine, which the ſame morning, between ſix and ſeven, had marked eighteen degrees in my apartment at Naples, being laid flat in the bottom of the grotto for half an hour, aſcended twelve degrees, and fixed at thirty above congelation, by nine in the morning. This heat, as we ſee, is ſomewhat leſs than what is ſometimes felt at Paris even in the exterior air. The ſame inſtrument aſcended to the fortieth degree in the hot houſes near San Germano, where I found by experience that even the pains of rheumatiſm were ſuſpended. Another thermometer of the like graduation, but made with mercury, being expoſed in the ſame place, exceeded not thirty-nine degrees. A little farther, the ſame inſtrument plunged into the large ſhoot of boiling ſprings of Piſciarelli, to the North-eaſt of Solfatara, ſcarce reached ſixty-nine degrees, ſo far was it from exceeding eighty; which would have been the caſe, if it were true, as is commonly ſaid, that theſe ſprings are hotter than common boiling water.

There might, without doubt, ſome curious reſearches be made here by a phyſician, who ſhould have leiſure to examine the bowels of Montenuovo, a ſmall mountain about a hundred toiſes high, which ſtarted up out of the earth in one night in the year 1538, near Puzzuoli, during the time of the eruptions of Veſuvius.

The 4th of June 1755, I had the honour of accompanying his ſerene highneſs the margrave of Bareith to the ſummit of the mountain, and even to the brink of the funnel which had formed itſelf round the mouth of the volcano ſince its laſt exploſion. This funnel was opened amidſt a heap of cinders, calcined ſtones, and ſulphur, which ſtill burned here and there, tinging the very ſun with its colour, and exhaling through divers crevices. The heat was ſo conſiderable in ſome places, over which I paſſed very quick, that I felt it acroſs the ſoles of my ſhoes: I walked round this rampart of cinders, and having plunged a ſtaff, between four and five feet long, into one of the clefts, I drew it up again all in a flame.

I went cloſe up to the edge of the crater, in a place where it was moſt acceſſible, and which appeared to me to be the ſteepeſt on the inſide. There I laid me down on my belly, and ſtretched my head forward, in order to examine the inſide of this gulph, the ſmoak of which prevented me from ſeeing the bottom. At ſuch times as the wind diſperſed it, I could ſee down to the depth of forty toiſes or more, and I perceived therein a large arched cavity towards the north-eaſt of the mountain. I cauſed great ſtones to be thrown into this cavity, and counted by my watch twelve ſeconds, before the noiſe of their rolling ceaſed to be heard. At the end of their fall, his highneſs the margrave, and ſeveral others, thought they heard a noiſe reſembling that which a ſtone makes when it tumbles into a ſlough; and when we caſt nothing in there, they heard a kind of boiling, like the ſound of agitated waves.

In aſcending the mountain, I had the mortification to ſee my portable barometer break in the hands of my conductor, at the very inſtant when I was on the point of reaping the fruit of the trouble it had given me by its carriage from Paris. The ſhortneſs of my ſtay at Naples did not permit me to repair this loſs; nor to meaſure geometrically the height of Veſuvius, which has never been well determined*. Father Torre obtained the neceſſary permiſſion for me to obſerve the height of this mountain; but his friendſhip and obligingneſs could not remove other difficulties. This father has juſt publiſhed a new hiſtory of Veſuvius, in which naturaliſts will find wherewith to ſatisfy their curioſity*. The eruptions of this volcano have been frequent for many years paſt, and every time that it darts forth its flames, and vomits out its liquid matter, the exterior form the mountain, as well as its height, receive conſiderable alterations.

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* I have been aſſured, that there is no dependence to be laid on the account given of it in the Memoirs of the Academy of Naples.

In going down, I ſtopped on a riſing ground, in a ſmall plain reſembling a half-moon, called Atrio di Cavallo, ſituated between the mountain of cinders, the ſtones caſt out of the boſom of the volcano, and a ſemicircular theatre of ſteep rocks, two hundred feet high, which fortify this little place or valley on the north ſide. There I viewed cloſely the breathing-holes lately opened in the ſides of the mountain, and through which, at the time of its laſt eruption, thoſe torrents of inflamed matter had eſcaped, to which they give the name of Lava, and with which all this valley is filled.

This ſingular ſpectacle preſents us with the appearance of metallick waves grown cold

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* This hiſtory has been tranſlated into French.

cold and in a ſtate of congelation. One may form a ſlight, but very imperfect idea of it, by ſuppoſing to ourſelves a ſea of thick and tenacious matter, the waves of which were beginning to ſubſide. This ſea had its iſles; which are ſolitary maſſes, reſembling hollow, ſpongy rocks, opening into arcades and grottos, fantaſtically formed, beneath which the burning liquid matter has made itſelf magazines or reſervoirs, not unlike furnaces. Theſe grottos, with their vaults and pillars, all the pure work of nature, were loaded with ſcoria, ſuſpended around them in the form of ſtalactites, or irregular cluſters of grapes, of all ſorts of colours and ſhades. I broke off ſeveral of the moſt remarkable fragments, which I carried to Naples, from whence they have not yet reached me now in two years time; thanks to the officious zeal of three different perſons, who contended for the pleaſure of ſending them to me*.

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* They are ſince ſafely arrived at Marſeilles, together with ſome other pieces of natural hiſtory; but no part of them is yet come to my hands, notwithſtanding all the trouble I have been able to take.

Both in aſcending and deſcending the mountain, I had all the neceſſary time to examine the matter of the lava in its various ſtates. I continued this examination in my ſeveral trips to Portici, a bourg ſituated at the foot of Veſuvius, where the king of the Two Sicilies has a houſe of pleaſure built on the ground which covers the ruins of Herculaneum.

They do not comprehend under the name of lava all the various ſorts of matter which iſſue out of the mouth of the volcano, ſuch as the cinders, pumice ſtones, ſand, gravel, &c. but only thoſe which, being reduced by the action of the fire to a ſtate of liquidity, form on cooling ſolid maſſes, in hardneſs ſurpaſſing even that of marble. But notwithſtanding this reſtriction, it is to be conceived, that there will ſtill be found many very different ſpecies of lava, according to the different degree of fuſion in the mixed matter, according as it participates more or leſs of metal, and becomes either more or leſs intimately united with the various kinds of materials of which it is compoſed. I have diſtinguiſhed, in particular, three general ſpecies, and there are no doubt, many intermediate ones. The pureſt lava looks, when poliſhed, like a ſtone of a dirty, obſcure gray: It is ſleek, hard, weighty, and interſperſed with ſmall fragments reſembling black marble, having whitiſh ſpecks; it ſeems to contain metalline particles; at the firſt glance of the eye it looks like the ſerpentine-ſtone, excepting that the colour of the lava approaches not towards the green; it receives alſo a pretty fine poliſh, which is more or leſs lively in its different parts. Tables, Chimney-pieces, and even ſnuff-boxes are made of it. I have ſeen at the court of Naples tables of an inch in thickneſs, ſome of which were veined and warped like a plank. The coarſeſt ſort of lava is uneven and rugged, and greatly reſembles the ſcoria of a forge, or the droſs of iron. The more common lava preſerves a medium between theſe two extremes. It is this ſort that we ſee diffuſed in large maſſes on the ſides of mount Veſuvius, and in the adjacent fields. There it has run in torrents, and formed, on cooling, maſſes like rocks, of a ferrugineous and ruſty colour, and oftentimes many feet in depth. Theſe maſſes are broken, and ſometimes covered over with heaps of calcined matter, ſhot forth out of the bowels of the volcano, and which fall again in the form of rain. The ſalts they contain mingling with the dried leaves of the trees, vines, and other plants, with which the mountain is covered, and with the dung which they carry there, form in time, and frequently in the interval between one eruption and another, a new bead of earth, extremely fertile, which another ſtratum of lava covers again in its turn. It is beneath ſeveral of theſe alternate beds of lava, cinders, and earth, all which put together form a cruſt of between ſixty and eighty feet thick, that they have found temples, porticos, ſtatutes, a theatre, and even an entire city.

I never was acquainted with the matter of the lava in America, though we frequently encamped for weeks, and even whole months, on the volcanos there, and particularly on thoſe of Pitchincha, Cotopaxi, and Chimboraco. I ſaw on thoſe mountains only the veſtiges of the calcination, without the liquefaction. However, the kind of chryſtal vulgarly called in Peru

Piedra de Gallinaco, ſeveral pieces of which I brought along with me, and a poliſhed lens of which, about ſeven or eight inches in diameter, may be ſeen in the cabinet in the king's garden, is nothing elſe but a ſpecies of glaſs, formed in theſe volcanos. The matter of the torrent of fire which runs down continually from that of Sangai, in the province of Macas, to the South-eaſt of Quito, is, without doubt, a lava; but we ſaw this mountain only at a diſtance, and I was not at Quito at the time of the laſt eruptions of the volcano of Coto-paxi, when a kind of ſuſpiracles * opened on the ſides of the mountain, from whence was ſeen to iſſue in waves an inflamed and liquid matter, which muſt be of the like nature with the lava of Veſuvius.

It is well known, that Naples is paved with this lava; but it is ſurpriſing that nobody has yet remarked that the pavement of Rome is alſo compoſed of the ſame materials. I may ſay as much of the pavement

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* See the Hiſtorical Journal of a Voyage to the Equator, printed at the Louvre in 1751, p. 156, and following.

ment of the greater part of the ancient Roman highways, and perhaps of all thoſe of which any veſtiges are remaining from Rome to Naples, as well as on the road from Naples to Puzzuoli and Cumea. In ſhort, it is the ſame with the Appian way, which ſtill ſubſiſts, and makes a part of the high road from Rome to Naples. This antique pavement is entirely compoſed of lava.

We ſhall be leſs ſurpriſed at this, when we come to know that the foundations of the houſes in the ſubterranean city of Herculaneum, built now two thouſand years ago are pure lava. This is ſufficient to determine a queſtion diſcuſſed in the Academy of Belles Lettres, and proves evidently that the great eruptions of Veſuvius are not all of them poſterior to that which ſwallowed up the city of Herculaneum. But though this city is, in fact, buried under ſeveral ſtrata of lava, properly ſo called, yet we muſt not imagine that its ſtreets, its ſquares, and its buildings, are covered with lava: Were this the caſe, neither the pick-axe nor chiſel would be able to penerate there. The matter with which the interior parts of the city are filled, has never been either fuſed or liquid. It is only one immenſe maſs of cinders, earth, gravel, ſand, coal, pumice-ſtones, and other materials, launched forth through the mouth of the Volcano at the time of its exploſion, and fallen again in heaps in all the circumjacent parts. Theſe at firſt buried all the houſes; by degrees, they penetrated into the interior parts, as well by their own proper weight, as by the aſſiſtance of the wind and rains, and laſtly, by the roofs and timbers giving way. This mixture being united by the infiltration of the waters, has condenſed in proceſs of time, and formed a kind of ſand-ſtone, more or leſs hard, but every where eaſy to be dug through. Such is alſo the ſoil of the heights which command Naples to the North and to the Weſt; viz. thoſe of Capo di Monte, the caſtle of St. Helena, and the Charter-houſe, but more particularly the ſteep hill which we ſee on the ſea-ſhore, as we go out of the city to the Weſt. Such again is the ſoil of the eminence into which is dug that famous ſubterranean antiquity, above half a mile long, known under the name of Pauſilyppo's grotto.

All the mountains and hillocks in the environs of Naples will viſibly appear on an examination to be nothing more than a maſs of various ſorts of matter, vomited forth by volcanos which no longer exiſt, and whoſe eruptions, anterior to hiſtory, have probably formed the ports of Naples and Puzzuoli. But it is not in Naples only, and its neighbourhood, that I have found the like kinds of matter. My eyes being accuſtomed to diſtinguiſh the different emanations of Veſuvius, and eſpecially the lava, under all its various appearances, diſcovered it, beyond room for doubt, on the whole road from Naples to Rome, and even at the very gates of the latter, ſometimes pure, ſometimes mixed, and combined with other materials

All the interior part of the mountain of Fraſcati, on which ſtood Cicero's Tuſculum, the chain of hills extending from Fraſcati to Grotta Ferrata, Caſtel-Gandolfo, and as far as the lake of Albano, a great part of the mountain of Tivoli, together with thoſe of Caprarola, Viterbo, &c. are compoſed of ſeveral beds of calcined ſtones, pure cinders, ſcorias, gravel, and materials reſembling droſs of iron, baked earth, and lava, properly ſo called; in ſhort, all like thoſe of which the ſoil of Portici is compoſed, and thoſe which iſſue out of the ſides of Veſuvius, under ſo many different forms. One may diſtinguiſh by the eye all theſe ſeveral ſubſtances: the cinders may be diſcovered both by their colour and taſte. It is impoſſible for any one, who examines with attention the productions of Veſuvius, not to obſerve a perfect reſemblance between them and thoſe which we meet, every ſtep we take, on the road from Naples to Rome, and from Rome to Viterbo, Loretto, &c. It follows then neceſſarily, that all this part of Italy has been overturned by volcanos. Theſe plains which at preſent appear ſmiling and fertile, covered with olive-trees, mulberry-trees, and vineyards, as are alſo to this very day, even the ſides of Veſuvius, have formerly been, like them, over-run with burning waves, and like them bear, not only in their bowels, but even on their ſurface, the veſtiges of thoſe torrents of fire, the billows of which are at preſent grown cold again and condenſed: irreſiſtible teſtimonies of vaſt conflagrations anterior to all hiſtorical monuments.

I pretend not to revive the ſyſtem of Lazzaro Moro, a Venetian author, whoſe work (printed at Venice in 1740) I was not ſo much as acquainted with, when I made the tour of Naples. He aſſerts that all iſlands and mountains wherein are found marine bodies, and of courſe the continents which ſerve as baſes to theſe mountains, have all ſprung out of the boſom of the deep, by the efforts of ſubterranean fires. Hiſtory furniſhes him with proofs for a pretty conſiderable number, the reſt he concludes by induction. His aſſertion, the truth of which I am unwilling to deny, is too general to be completely proved: I confine my own to ſimple facts, and draw from thence only the neceſſary conſequences. When I ſee in an elevated plain a circular baſon ſurrounded with calcined rocks, the verdure with which the neighbouring fields are covered impoſes not on me; I inſtantly perceive there the ruins of an ancient volcano, as I ſhould perceive beneath the ſnow itſelf the traces of an extinguiſhed fire, on ſeeing a heap of cinders or coal. If there be a breach in this circle, I uſually find out by following the declivity of the ground, the traces of a rivulet, or the bed of a torrent, which ſeems as it were hollowed in the rock; and this rock when examined cloſely, appears frequently to be nothing more than lava, properly ſo called. If the circumference of the baſon has no breach, the rain and ſpring waters which aſſemble there, and have no iſſue, generally form a lake in the very mouth of the Volcano.

The repreſentation alone, on a topographical chart, of the lake of Albano, with its ſteep ſides and circle roughened with rocks, called to my remembrance the lake of Quilotoa, which I have elſewhere deſcribed*, and whoſe waters ſometimes exhale fumes of fire. A few Days after, the ſight of the lake of Albano itſelf, and the calcined matter with which its banks are powdered, left me no room to doubt any longer of its origin. I ſaw manifeſtly the profound funnel of the ſhaft of an ancient Volcano, in the mouth of which the waters had accumulated themſelves. Its eruption, of which hiſtory makes no mention, muſt have been anterior to the foundation of Rome, and even of Alba, from whence this lake has taken its name, a period amounting to near three thouſand years.

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* Hiſtorical Journal of a Voyage to the Equator, page 61.

At the ſight of the traces of fire diffuſed in the environs of the lakes of Borſello, Ronſiglione, and Bracciano, on the road from Rome to Florence, I had formed the ſame conjectures, before I had ſeen either Veſuvius or the matter which it vomits forth. I paſs the ſame judgment by analogy on the lake of Perugio, and ſeveral others in the interior parts of Italy, which I know only by the map.

In ſhort I look upon the Apennine as a chain of volcanos, like that of the Cordilleras of Peru and Chili, which runs from north to ſouth, the whole length of South America, from the province of Quito to the Terra Magellanica. The courſe of the volcanos of the Cordilleras is interrupted; a great number of them are either extinguiſhed or ſmothered; but ſeveral ſtill remain actually burning. The old ones alſo frequently revive, and ſometimes new ones are kindled even in the bottom of the ſea; nor are their effects, on that account, leſs fatal. In a few years time both Lima and Quito, two capital cities of Peru, became the victims of theſe two kinds of volcanos. The chain of thoſe of the Apennine, which divides the continent of Italy, in like manner from north to ſouth, and extends as far as Sicily, preſents us ſtill with a pretty great number of viſible fires under different forms; in Tuſcany, the exhalations of Firenzuola and the warm baths of Piſa; in the eccleſiaſtical ſtate, thoſe of Viterbo, Norcia, Nocera, &c. in the kingdom of Naples, thoſe of Iſchia, Solfaterra, and Veſuvius; in Sicily, and the neighbouring iſles, Ætna or Mount Gibel, with the volcanos of Lipari, Stromboli, &c. but other volcanos of the ſame chain being either extinct, or exhauſted from time immemorial, have left only ſome remains behind; which although they may not always ſtrike at the firſt ſight, are not at all leſs diſtinguiſhable o attentive eyes. In ſhort, the earthuakes which have at various times overurned ſeveral of the cities of Italy and Siily, that which ſwallowed up the city of t. Euphemia in 1638, and of which Kirker has drawn ſo pathetick a picture, that hich deſtroyed Catano in 1693, that hich opened the gulphs of Palermo in 718, that which ſince the reading of this memoir has overturned Syracuſe, recall to y remembrance the diſaſters of Valpariaſo, Callao, Lima, and Quito, in South Ameica, and cloſe the parallel between the Cordilleras of Italy and thoſe of Peru: the marks of reſemblance between them are ut too ſtriking.

I affirm not that all theſe mountains are n the ſame ſtate with the Apennines. I ave not obſerved the ſame appearances in hat part of the Alps which I traverſed, but I have found ſome ſimilar ones in Dauphine, Provence, and ſeveral places where they ave never yet been regarded as proceedng from the action of fire *. It is not then in

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* In 1760, three years after the reading of this memoir, I brought from Balaruc, a village of Languedoc,

in Italy alone that we find veſtiges of calcination and vitrification in places where volcanos have never been ſuſpected. The ſame may be ſaid of France, and perhaps of every other country. My conjectures on the ancient volcanos of Italy, the traces of which I ſaw every where, and the lava, which I found beneath my feet, in places where it had never been ſuſpected, ſeemed to me ſo evident, that all my aſtoniſhment was, that they ſhould appear new; nevertheleſs they were thought whimſical, not to ſay ridiculous, in a country where I am ſtill of opinion, that in order to form the like, it is ſufficient merely to open one's eyes. I learn, that they will probably be better received in France: it will require no difficulty to believe that a great part of Italy is covered with the ſhattered remains of ancient volcanos that are unknown to us, and with lava, properly ſo called, in all reſpects

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guedoc, ſituated on the ſea ſhore, and celebrated for its warm waters, fragments of a porous ſtone, calcined like a pumice, but hard, blackiſh, and weighty, and in all reſpects reſembling the coarſeſt ſort of lava, or rather thoſe ſtones which floated in the lava while yet liquid, which are impregnated with it, and ſometimes confounded with the lava itſelf.

reſpects like that of Veſuvius, ſeeing that M. Guettard, whoſe memoir, publiſhed in my abſence §, I was entirely ignorant of, has diſcovered a perfect reſemblance between this matter and thoſe which he has found in Auvergne, on a compariſon made by him of the fragments of the lavas of Veſuvius and Mount Gibel, which had been ſent from Italy, and the different lavas which he has diſcovered on the mountain of Volwick, on the Puy de Domme, and on the Golden Mountain.

I learn ſtill farther that they build at Clermont, in the ſame province, with a porous and yet very hard ſtone, which I ſuſpect to be of the ſame nature with the ſtone of Tivoli (Lapis Tiburtinus) now Travertino, uſed in the moſt ancient edifices of Rome, ſuch as the priſon of the Tullianum, built under Tullus Hoſtilius. This ſtone bears marks of the action of fire upon it, and is a kind of coarſe and porous fragment, ſeemingly impregnated with a mixture

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§ Memoirs of the Academy of Sciences for 1752, printed in 1756.

mixture of heterogeneous matter. In another ſtone very common at Rome, and which they call there Peperino, we ſee incorporated pieces of white marble, reſembling that which we frequently find whole veins of on the mountain of Veſuvius, and in the clefts of the rock bordering on the little plain in the Half Moon, which I have already mentioned: one may diſtinguiſh alſo in the ſame ſtone, which may poſſibly be nothing more than a leſs pure ſort of lava, fragments reſembling black marble. In the laſt eruptions of Veſuvius, pumice and other ſtones half burnt, have been ſeen floating on the ſurface of the burning and liquid lava. It muſt often come to paſs that ſtones plunged and retained by ſome obſtacle within the liquefied maſs, are penetrated to all intents by the various fuſed materials of which the lava is compoſed. I have brought home a coal, which I drew out of the cavities of a ſtone, in the caſtle of Citta-Caſtellana, one day's journey from Rome. To what other cauſe can we more naturally attribute the interior diſpoſition of certain rocks, ſuch as are ſeen in divers places on the coaſt of Genoa, particularly to the north of Cape Mela? The rock there is cut as it were with a pick-axe, and its vertical ſection diſcovers all the inſide: we ſee in it a jumble of ſeveral matters differently coloured, which are not diſpoſed in ſtrata, but wavey, and in the form of eddies, whoſe aſpect alone recalls to our minds the idea of ſome kind of marble papers, and ſeems as if theſe materials had been ſurpriſed and fixed in their ſtate of bullition. What is then that ſpecies of ſand or duſt found in the environs of Puzzuoli, which is commonly called Puzzuolaneum, and great quantities whereof are found in many other places where it is not known, but an amalgama of calcined ſtones mingled with ſcorias and iron ruſt reduced to powder? I am alſo very much tempted to believe, that the black and metallick duſt, ſo common in America, and on which M. Muſſchenbroek made ſeveral experiments*, is a production of volcanos.

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* M. Muſſchenbroek, in his diſſertation on the loadſtone, informs us, that the ſand, on which he tried his experiments, came from Virginia. I found it in all parts of Peru, and it is very common in the province of Quito.

But however the caſe be with reſpect to theſe laſt conjectures, they have nothing in common with what I advance on the ſubject of the pavement of Rome, the Appian way, &c. I repeat it, that in order to perceive the ſame matter there as the lava of Veſuvius, it needs only eyes: as for thoſe which require authorities to ſupport them, I ſhall cite Wagner, a learned naturaliſt, and phyſician to her royal highneſs the margravine of Bareith, whom I found of the ſame opinion with myſelf, when I communicated to him my thoughts on the materials of the pavement of the Roman highways in the environs of Naples and Rome. He added to me, that in three different journeys from that capital to Florence, he had obſerved from the mountain of Radicofani, thoſe ſeveral ſpecies of calcined matter, which I myſelf had begun to obſerve, only from the environs of Aquapendente, and the reſemblance of which to the lava of Veſuvius I was not yet acquainted with. Another ſuffrage no leſs deciſive in a ſimilar caſe, is that of M. Soufflot, comptroller of the king's buildings. Since the reading of this memoir at the public recital, I have learned from him, that in his laſt tour to Italy in 1752, he went to Capo-di-Bove, half a league's diſtance from Rome, out of the quarry at which place the pavement of that city is drawn; and that he perceived that this pretended ſtone differed not at all from the lava, with which the ſtreets of Naples are paved. The ſame material might be drawn from a place much nearer to Rome than Capo di-Bove: for I myſelf have ſeen pure lava as we go out of the city, and that to very near the gate of St. Sebaſtian, on the road from Fraſcati to Rome. It is aſtoniſhing that a fact ſo eaſy to be verified, ſhould ſtill, eſpecially at this time of day, have the air of a paradox, and not be more generally known.

The prince of San Severo, gentleman of the bed chamber to his Sicilian majeſty, knight of the order of St. Januarius, and celebrated for his knowledge in various branches of literature, as well as for his taſte in chymiſtry and the arts, furniſhed me with a ſight at Naples of ſome attempts towards a new ſpecies of a very ſhort ve-

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getable ſilk, which they had not been able till then to ſucceed ſo far in as to ſpin. They extract it from a tree which grows in the country, the leaves whereof differ very little from thoſe of the Sallow-tree, and which by botaniſts is called Apocynum, or Dogs-bane. This ſilk very much reſembles that which is drawn from a large tree in America, called Fromager (or the cheeſe tree) in our iſles, and Seyba by the Portugueſe of Para. They make no manner of uſe of it in the French colonies: but I ſaw it employed at Para, in the making of feather beds. The prince of San-Severo has given me ſone patrons of this ſilk thread, and likewiſe of the ſtuff which he had cauſed to be made of it. It is of the colour of fire, and looks like a waled, watered tabby that is very thick: It takes no luſtre, but by paſſing under the calender.

Naples had a few years ago an academy of ſciences, a volume of whoſe labours has even been publiſhed. The zeal of a few individuals gave birth to it; but it ſubſiſted not long, for want of proper regulations and protection. They talked in 1755 of forming a hiſtory, under the authority of the government, for deſcribing and explaining the antiquities of Herculaneum: And we have ſince ſeen appear two volumes in folio, containing explanations of theſe monuments, publiſhed by the ſaid ſociety.

Travellers uſually chooſe to make the tour of Naples at the time of the feaſt of St. Januarius, when they are deſirous of being made eye-witneſſes of a fact as extraordinary as it is true; and which is held in in that country for ſupernatural. They expoſe then, on the principal altar of the cathedral, the head of St. Januarius, biſhop of Naples. They place near this relique a phial of chryſtal, ſet in a very rich mounting, and which, according to tradition, contains the blood of St. Januarius. This phial is ſhook for ſome time, and ordinarily, after ſeveral ſhakings, the matter contained in it appears to liquefy before the eyes of all preſent; I ſay ordinarily becauſe it does not happen ſo always, and at ſuch times the people of Naples are thrown into the greateſt conſternation. I lamented that

I had quitted Naples without having been preſent at this ſolemnity, when chance, in ſome meaſure, made me amends for it. Being gone one evening to pay my court to her royal highneſs the margravine of Bareith, a phial was brought to that princeſs, ſet in a circle of braſs or ſilver gilt, and mounted on a pedeſtal very richly ornamented, which was ſurmounted again with a caduceus, in order to diſtinguiſh the mounting of this from that of the phial kept in the cathedral. All this apparatus was put in the hands of the princeſs, from whence it paſſed into thoſe of the margrave, and ſeveral other perſons, as well as into mine; and the following is a true account of what we all ſaw. The phial appeared to be half filled with a gray-coloured fixed maſs or paſte, and its ſides tarniſhed with duſt. On inclining it alternately ſeveral ways, and ſhaking it for about half a minute, more or leſs, the paſte became liquid, and melted; ſometimes only partially; at other times it grew fixed again, and on ſhaking it anew it was either a ſhorter or longer time in liquefying. All this was done before our eyes; and what is ſtill more deſerving of notice, in ſuch a manner that neither the will nor deſire of the perſon who ſhook the phial, could promote or produce either the one or the other at his diſcretion. This is what I have been an eye-witneſs to on ſeveral occaſions, not only the evening I mentioned, in preſence of their highneſſes, but ſince more particularly, and in broad day, at the keeper's of the machine, where I had all the neceſſary time to examine it. I obſerved beneath the phial two ſmall cones, I know not of what material, with their points oppoſed to each other, which he informed me were perforated with a ſmall opening. He further added, that they were hollow, and that the lower cone was moveable, in ſuch a manner that its orifice ſometimes met with that of the upper cone and at other times did not; all this was purely accidental, and juſt as the motion impreſſed on the phial cauſed, or not, the axes of the two cones to concur. As for the duſt which I ſaw in the phial, they told me it was an amalgama of mercury, lead, tin, and biſmuth; that the biſmuth which mingles but very imperfectly with the other ingredients, prevented the mixture from becoming an abſolute fixed paſte, and gave it the form of a powder, too thick to paſs through the little opening which communicated with the two cones. Laſtly, they added, that in a circular channel, concealed in the mounting, was contained ſome running quickſilver; that by ſhaking the phial irregularly, when the orifices of the two cones met, this mercury inſinuated itſelf in a greater or leſs quantity, and liquefied the amalgama; that it came to paſs ſometimes, that by the variety of motions impreſſed on the machine, the mercury, ſo introduced, returned again by the ſame opening, and that then the amalgama ceaſed to be fluid. I relate with all poſſible exactneſs what the poſſeſſor of this ingenious machine told me, and which I alſo ſet down in writing the ſame day: All that I can certify for fact is, that it performed its operations extremely well. He promiſed me at that time an exact deſcription of it, together with a draught of all its parts, to be communicated to the Academy. He has ſince renewed the ſame promiſe to me in writing, but has not yet fulfilled it *.

At my return from Naples to Rome, Cardinal Valenti, miniſter and ſecretary of ſtate to his Holineſs, did me the honour of putting into my hands ſix copies of a new Italian tranſlation, done and printed at

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* This memoir, read in the Acadamy in 1757, was not printed till 1762.

Mr. Addiſon calls this whole affair of the liquefying of the blood of St. Januarius one of the moſt bungling tricks he ever ſaw. Mr. Addiſon's word would have gone as far as any man's; yet I muſt confeſs, for my own part, that I have never read the ſhort account he gives of it, but I have always wiſhed, that he had ſhewn us wherein it was bungling. M. de la Condamine, with that happy curioſity for which he is ſo remarkably diſtinguiſhed, has here explained the whole juggle, upon ſuch mechanical principles, as, though they entirely deſtroy the credit of the miracle, yet, at the ſame time, prove the means by which this wonderful feat is effected to be very ingenious. On this occaſion, one cannot but admire the candour of the writer, who, though no doubt a violent Papiſt, yet is ſo far from being bigotted to any peculiar mode of thinking, that we owe to him the detection of one of the greateſt impoſitions of the church of Rome. The reader muſt not be offended, if I go one ſtep farther, and charge Mr. Addiſon, on the other hand, with an over-weening zeal againſt the Roman Catholic religion, in calling that trick bungling, which it is plain, even from his own account of the matter he knew nothing at all of.

at Rome by his order (though it bears the name of Lucca in the frontiſpiece) of my memoir on the inoculation of the ſmall-pox, read the year before at Paris in a publick aſſembly of this Academy. In the converſation which I had on this ſubject with his eminence, he gave me to underſtand, that no theological ſcruples, ill underſtood, would be oppoſed at Rome to the eſtabliſhment of a practice which tends to the good of mankind. The divines with whom the cardinal-miniſter had conferred on this head had taken care to inform themſelves of the true ſtate of the queſtion, that no alarm might be taken at any falſe repreſentation of it; and they delivered it as their opinion, that it was perfectly conformable to the principles of Chriſtian charity, to annihilate, or at leaſt almoſt to annihilate, that evident riſk of death, which every infant that comes into the world is expoſed to during the whole courſe of his life.

I learned at the ſame time, that the maternal tenderneſs which in other places retards the progreſs of inoculation, had been an incitement to the mothers in ſome parts of the Eccleſiaſtical State. The mothers there, without waiting for the hand of the ſurgeon, inoculated their children themſelves, while they were aſleep, and even without the knowledge of their fathers, by a ſimple puncture. Never did operation ſucceed more happily. The Journal des Scavans of Rome has given us an account of it, in their number for July 1755*. The ſame year inoculation was introduced into Tuſcany, by authority of the government, in the hoſpital at Sienna; and in the autumn of 1756 into that of Florence. It has actually eſtabliſhed itſelf at Piſa. Doctor Targioni has juſt publiſhed at Florence a relation of his ſucceſs. This method gains ground, and becomes more extenſive every day. From Geneva it has paſſed over into Swiſſerland and Germany, where the moſt eminent phyſicians have declared in its favour †. Holland, Denmark, and

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* Giornale di' Litterati. Luglio, 1755.

† M. Vanſwieten wrote me word in January (1757) that he intended to perform ſeveral inoculations the ſpring following. See M. Haller's letter to M. Tiſſot, entitled, "Inoculation juſtified." Alſo a manuſcript letter from M. Wherloff to M. de la Virotte.

Sweden, have alſo adopted it. I mention not England, as there it has not one ſingle opponent among the ſurgeons and phyſicians. Behold us then on all ſides inveſted by inoculation. The Spaniards are the only neighbouring people among whom it has not yet found means to inſinuate itſelf. So far we are obliged to them, in that we have not been the laſt nation in Europe to adopt ſo ſalutary a practice: But, in the mean time, that the whole nation may reap the fruit of it, we have illuſtrious examples before our eyes; one ſingle inſtance of which proves more in favour of this method*, than a thouſand others, which have only for their principle a ſervile and mechanical imitation. Our divines would be aſhamed to aſk ſeriouſly, if it be permitted in conſcience to make uſe of a precaution, the effect of which, as confirmed by new and daily experiments, is to ſcreen annually ſeveral thouſands of victims from the ſmall-pox, when taken in the natural way. Our biſhops and our magiſtrates know not, that it was an anonymous perſon who firſt impeached inoculation at their tribunal; but they are not ignorant, that M. Chais[*] had beforehand replied in a victorious manner to all the moral and theological objections that had been made to it, dictated by a zeal more ardent than illuminated; and that Father Berti, an Auguſtine, and one of the moſt learned divines in Florence, together with ſeveral other Catholick doctors in Italy, have publickly undertaken the defence of the ſmall-pox in the artificial way. There remains then no longer either reaſon or pretext for alarming the conſciences of thoſe, who forgetting the evidence, are determined only by authority.

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* The inoculation of his Grace the Duke of Chartres and Madam de Montpenſier, his ſiſter, in 1755.

With regard to the phyſicians who have openly avowed their writings againſt inoculation, though their names, their number, and the general tenour of their works may be calculated to impoſe upon us, yet I ſhall not inſiſt the leſs ſtrenuouſly, that the buſineſs of a phyſician, in point of inoculation, is only to examine, whether the particular habits of the perſon who preſents himſelf do not render him unfit to reap the benefit of his operation. For this purpoſe the phyſician the moſt ſkilful and experienced, ought undoubtedly to be conſulted in preference to all others. But as to the general queſtion, "whether inoculation be a ſalutary practice?" or even the other queſtion, "whether it be adviſeable to inoculate infants?" the deciſion of theſe turns upon nothing more than a pure calculation of probabilities. The problem being reduced to this compaſs, becomes of that kind of operations which is common to lotteries, and belongs only to arithmetick, inaſmuch as to reſolve it we need only caſt our eyes on the liſts of perſons inoculated in the ſmall pox hoſpitals, and that for foundlings at London. With reſpect to the calculation of the riſk by inoculation to adults of different ages, the problem there becomes more complicated, and the moſt ſubtile analyſis is not able yet to determine it but by approximation, on account of the imperfect ſtate of the bills of mortality, eſpecially in

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[*] Apologetical Eſſay on Inoculation, by M. Chais, printed for De Hond at the Hague, in 1754, and ſold by M. Briaſſon at Paris.

France[*]: but it is not the leſs evident on that account, that inoculation would preſerve to the ſtate a great number of ſubjects who periſh by the ſmall pox in the natural way; nor is it leſs true, though leſs evident, that from its being advantageous to the ſtate, it neceſſarily follows that Providence dictates the uſe of it to individuals, unleſs it be in extraordinary caſes. Inoculation henceforward will have for its enemies only thoſe who are not able to attain to this truth demonſtrated as it is; or ſuch as, being convinced in themſelves, yet have certain reaſons to contend with, which they are afraid to bring to light[†].

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[*] In the bills of mortality publiſhed in France, they inſert the number of the dead, without diſtinguiſhing their ages and diſeaſes. In thoſe of London, which are much more perfect than ours, we ſee on one ſide how many perſons die at each ſeparate age, and on the other, how many die of every diſorder; but both theſe matters are not united again in one point of view, and we ſee not in what proportion the mortality occaſioned by any particular diſorder, ſuch for example as the ſmall pox, diffuſes itſelf over perſons of different ages.

[†] The whimſical but ingenious doctor Douglas, in his account of the Britiſh ſettlements in America, vol. II. page 398, &c. gives us the following ſtate of the ſmall pox in Boſton, from January 1752, to

July

My abode at Rome being prolonged, and my health re-eſtabliſhed there, I pro-

cured

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July 24, from whence the proportion between thoſe who die in the natural and artificial way may in ſome meaſure be determined, viz.

Small-pox in the natural way, 5059 whites, 485 blacks, whereof died 452 whites, 62 blacks. By inoculation 1970 whites, 139 blacks, whereof died 24 whites, 7 blacks. Thus there died of inoculation 31 perſons, not including the dubious deaths of Mr. Coleman's ſon, who died by ſubſequent nervous diſorders and ſore eyes, and the two daughters of Mr. Goldthwait, who died under inoculation, but, as it is ſaid, by the ſore throat illneſs. Died then of an inoculated ſmall-pox, about one in eighty-two whites, and one in twenty blacks. In the Boſton ſmall-pox of 1752, there died whites in the natural way about one in eleven; by inoculation one in eighty: blacks in the natural way, one in eight; by inoculation one in twenty. In Charles-town, South Carolina, when the ſmall-pox prevailed in 1738, upon a ſcrutiny, it was found that in the natural way, of 647 whites, died 157, which is one in four; by inoculation of 156 whites, died nine, that is to ſay, one in twenty: of 1024 blacks in the natural way, there died 138, which is one in ſeven and a half; and of 251 blacks by inoculation, there died ſeven, or one in thirty-ſix. In the natural way 1721, died about one in ſeven; 1730, about one in eight; 1752, nearly one in eleven; 1721, Mr. Bond, a carpenter, and five of his children, died with purples and hæmorrhage, in Boſton; 1752, four children of Mr. Weir of Charles-town died, whereof one was inoculated; 1752, of the ſmall-pox decumbents in Boſton, died about one in eleven; 1713, Timonius from Conſtantinople ſent to the royal ſociety in London in-

credible

cured a clock from Paris, with a metal pendulum, whoſe vibrations laſted for twenty

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credible recommendations of this practice: " that for the preceding eight years ſome thouſands had been inoculated, and none died; while at the ſame time half of the affected in the common way died in Conſtantinople; and, what is valued by the fair, inoculation never leaves pits or ſcars: children have no convulſions. Pylarini, the Venetian conſul at Conſtantinople, in 1714, ſent to the royal ſociety a more modeſt account of the ſame. Dr. Le Duc, a native of Conſtantinople, and who was himſelf inoculated, aſſured Dr Jurin, that out of many thouſands, in the ſpace of about forty years paſt, who had been inoculated in and about Conſtantinople, by one Greek woman, not ſo much as one perſon had miſcarried. 1721, I lent, (ſays Dr. Douglas) theſe communications to Dr. Cotton Mather, a clergyman of Boſton; being very credulous, he ſent a raſh operator to work, and about 286 were inoculated, whereof about one in forty-eight died at Boſton.

In the ſpring of 1722, by direction of the princeſs of Wales, ſix hoſpital children, and ſoon after five more hoſpital children, from about fourteen weeks to twenty years of age were inoculated; ſome did not receive the infection, as having had it formerly, or from ſome other impediments, but none died or ſuffered much. Upon this encouragement, Mr. Amyand, ſerjeant ſurgeon, was ordered to engraft the ſmall pox on princeſs Amelia, aged eleven, and princeſs Carolina, about nine: they had them favourably. This encouraged the practice; and from the accounts of Dr. Jurin, ſecretary to the royal ſociety (a great promoter of inoculation) in the firſt three years, 1721, 1722, and 1723, of the practice, in all Great Britain were inoculated 477 perſons twenty-four hours, and the very ſame with which I had made my experiments at Quito, at Para, at Cayenne, and at Paris. Father Boſcovick the jeſuit, a celebrated geometrician, one of thoſe who meaſured two degrees of the meridian of Rome at Rimini, procured me all poſſible conveniencies for repeating my experiments on the pendulum

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ſons, whereof nine are ſuſpected to have died; and as of theſe twenty-nine did not receive the infection (this is one in ſixteen) the deaths were nine in 448, or two per cent. in this period of three years. In making of medium eſtimates, we ought to take large numbers in a long ſeries of time, but not the caſes of ſingular families, where ſome may ſay that notorious circumſtances were not avoided or attended to, ſuch as pregnant women, child-bed women, old negroes, and the like. We had a remarkable inſtance in the inoculations of Boſton 1752, of five perſons in one family, Mr. Sherburn's, inoculated by Mr. G——r, three died. Of 72 or 73 perſons inoculated in 1721 in Roxbury and the adjacent country towns, by Mr. B——n, five died, which is about one in fourteen. In ſhort the riſk ſeems to be only two to three per cent. and by the purging method, and ſome prudential cautions, might be farther reduced. In the Boſton inoculations, upon an actual ſurvey it was found that in about 2000 inoculations, thirty-one had died, (others including ſome diſputed caſes, ſay thirty-four) the promoters gave out 3500 inoculated, but gradually reduced the number to 3000, and afterwards to 2500, (ſee the Boſton Gazettes, publiſhed in June 1752) and at the laſt acquieſced in the actual ſcrutiny of about 2109.

dulum in the Roman college, where he had traced out a meridian. Theſe were made and continued again more under his inſpection than mine for nine days together, at different intervals. The reſult was, that in the month of October 1755, my pendulum performed at Rome 98865½ vibrations in twenty-four hours middle time, Reaumur's thermometer pointing then at ſeventeen degrees above congelation. This number being compared with that of the oſcillations of the ſame pendulum at Paris, at Quito, at Cayenne, at Para, in the ſame ſpace of time, will give the difference of the length of a pendulum for ſeconds, in all theſe places with the greateſt preciſion, by reducing them all to the ſame degree of the thermometer. I went alſo ſeveral times to the college of Engliſh jeſuits there, and to the obſervatory of father Maire (father Boſcovick's colleague in his menſuration of the degrees) in order to obſerve at theſe places the immerſions of Jupiter's ſatellites on the occultation of the ſtars by the moon. The clouds rendered our preparations uſeleſs. Aſtronomers alone know with how many ineffectual obſervations one that ſucceeds is purchaſed. I reſerve for another opportunity my experiments on the thermometer, the barometer, and the declination of the magnetick needle, as well at Rome as in divers other places in the courſe of my tour.

Charles VIII. at his return from his expedition to Naples in 1495, founded a convent of French minims to the trinity of the Mount, in one of the moſt beautiful ſituations in Rome. The clock belonging to this convent is a great conſolation to ſtrangers, being the only one in the city by which you can learn what hour it is.

The eccleſiaſtical day beginning at midnight throughout the whole chriſtian world, and all the rites of the Roman church being regulated by it, it is ſomewhat extraordinary that the civil day ſhould not commence at Rome with the eccleſiaſtical, and that Italy alone, with a remarkable ſingularity, ſhould differ in a point of ſuch common practice from all the reſt of Europe. They begin counting the hours in Italy from the end of the day, a time equivocal, arbitrary, and morally impoſſible to be determined. This cuſtom ſavours viſibly of barbariſm, and recalls to our minds the time when ſome ſenſeleſs perſons thought they had ſettled the limits of day and night extremely well, by ordaining that the day ſhould be looked upon as ended when they ceaſed to diſtinguiſh objects. But what objects? at what diſtance? in what ſeaſon? and under what temperature of the air? Problems which require as many ſolutions as there are different objects, different diſtances, eyes differently formed, and different changes in the air.

From hence it comes to paſs that at Rome, and almoſt throughout all Italy, they count every day at noon one hour different from the evening before; and that noon-tide, which they nevertheleſs ſtand in need of knowing exactly on account of their eccleſiaſtical rites, varies more than three hours from winter to ſummer. At Rome, in the ſolſtice of June, at the hour of noon, the clock ſtrikes ſixteen; but in the winter ſolſtice, in December, nineteen. As the length of the day, eſpecially when taken from the twilight of the evening before to that of the next day, differs from one day to another ſeveral minutes; in order to avoid meddling every day with their clocks, they have conceived that they ought to wait till the differences ſo accumulated, from day to day, ſhould amount to about fifteen minutes: and that they may act conformably to this regulation, all the clocks of the city make a ſkip of a quarter of an hour on a day appointed, ſometimes at the end of eight days, ſometimes at the end of fifteen, and ſometimes after an interval of ſix weeks. For this purpoſe a printed almanack informs us, that from the 16th of February, for inſtance, to the 24th, it will be noon at a quarter paſt eighteen, but that on the 24th it will be noon at eighteen o'clock preciſely, and continue ſo till the 6th of March, &c. That from the 1ſt of June to the 13th of July, the hour of noon is to be reckoned at ſixteen o'clock; on the 13th of July at ſixteen and a quarter, and ſo on through the reſt of the months; inſomuch that in the ſpace of a whole year, the time of noon varies from fifteen to eighteen, and that not by an inſenſible progreſſion from one day to another,

ther, but by ſkipping a quarter of an hour between a fixed day and the day after, at the end of eight, or fifteen, and ſometimes after an uniform march of forty days. I have long conſidered with myſelf what advantage can poſſibly reſult to them from ſo whimſical a cuſtom; and the only one I have ever been able to conceive is, that it is very difficult at Rome to perceive when a watch goes wrong.

We may ſee that this cuſtom is not only founded on a groſs ignorance of the elements of aſtronomy; but that it is alſo embarraſſing in the practice. Such, however, is the tyranny of cuſtom, that in the country of Galileo, of Kirker, of Riccioli, of Caſſini, very few perſons will allow that this is the leaſt inconvenience. The moſt celebrated mathematicians of Rome, and among them the fathers Leſeur and Jacquier, French Minims, well known for their learned commentary on Newton, as alſo the Fathers Maire and Boſcovick, Jeſuits, have been conſulted with the view of knowing whether it would be proper to reform this cuſtom. It is eaſy to imagine what was their anſwer. The abuſe, nevertheleſs, ſtill ſubſiſts, and will ſubſiſt probably for yet a long while to come.

The emperor in his Tuſcan territories, and the infant duke of Parma in his, have cut within theſe few years this Gordian knot, by ordaining that the hours there ſhould be reckoned conformably to the cuſtom univerſally received throughout the reſt of Europe. It is not without difficulty that theſe princes make themſelves obeyed, and the murmurings on account thereof ſtill continue. What adds to the averſion of the vulgar, a name which extends very wide, is, that they have very unfortunately for the truth, taken into their heads to call ſuch of their clocks a la Francoiſe, as mark the hour of the day by beginning it at midnight and at noon. This title of their being French clocks is by no means calculated to ſerve as a recommendation to them. Beſides, they find it ſo eaſy and ſo natural to count the hours from the end of the ſenſible day; ſo ſtrange and ſo troubleſome to divide the night and the day in the middle, and to regulate the hours by the terms of midnight and of noon, of which there is nothing to inform the ſenſes, that without the aid of authority the old cuſtom had never been changed. It is in the convents of nuns in particular, that the aſtronomical method has found it difficult to introduce itſelf. By the ancient method of computation the hours of all the exerciſes of the cloiſter were different every day, or rather went under different names, though in fact they were the ſame. They went, we will ſuppoſe, to matines always at ſix hours after midnight; but this was ten in one ſeaſon of the year, and thirteen hours in another. The hour of dinner, which was fifteen in ſummer, and nineteen in winter, took ſucceſſively the name of all the intermediate hours, and yet every thing went on well. At preſent, by counting only from midnight, the nuns enter the choir all the year round at ſix in the morning; and the clock of their refectory ſtriking daily at noon, every thing appears to them in diſorder and confuſion.

Rome, as well as the greateſt part of the cities of Italy, has ſeveral literary ſocieties, which go under the name of academies. Theſe ſometimes hold public aſſemblies; wherein many pieces in verſe are read, particularly ſonnets, a kind of poetry, the taſte for which has ſupported itſelf in Italy with the ſame vivacity for upwards of theſe three centuries paſt. I aſſiſted on the ſeventh of Auguſt 1755, at an aſſembly of academicians called Quirini, who held their meeting in a grove of the gardens belonging to the palace of Corſini one of the moſt beautiful in Rome.

A verdant portico opening into arcades, and ſupported by rows of trees cut into columns, with their baſes and chapiters, formed a large circle round an octagon baſon. This rural periſtyle was ornamented with ſteps, and the circumference of the baſon with ſeats, for the numerous audience. In the bottom an amphitheatre ſtill more ornamented aroſe, which ſerved as a throne to the members. Fronting this, and right before the baſon, eighteen very rich chairs of ſtate, placed all in a ſemicircle, were occupied by the cardinals and ambaſſadors. This ſight for which I was not at all prepared, ſtruck me greatly. I thought myſelf tranſported into Elis, in the happy days of Greece, and that I ſaw the judges there diſtributing crowns to the victors in the Olympick games.

The Roman academy for ſculpture and painting has juſt been enriched with ſome new donations by the liberality of the ſovereign pontiff; and very lately alſo with a ſchool for deſigning and modelling, ſupported like that in the French academy, eſtabliſhed by Lewis XIV. and which maintains itſelf ſtill in its full luſtre.

But it is ſurpriſing not to find in this capital any ſociety for the cultivation of phyſics and the mathematics: Rome has no academy of ſciences. It is even but a few years ſince private aſſemblies have been held (ſome of which have antiquities for their object) in a city where the moſt beautiful monuments of the magnificence of the ancient Romans continually attract the attention. To this very hour there are neither funds nor penſions attached to theſe eſtabliſhments, which might render them ſolid, by aſſuring the lot of thoſe who compoſe them. Thus we may ſtill ſay, with reſpect to thoſe ſciences which are termed accurate, as well as with regard to the hiſtorical reſearches, that Rome wants a centre and point of re-union.

The Learned and Antiquarians there are diſperſed and divided. There are ſome, however, particularly in this latter claſs, who have rendered themſelves famous by their works. We are become acquainted with the names of Bottari, Pacciaudi, Bayardi, Bianchini, Vettori, Venuti, and ſeveral others; but many of them young fellows without fortune, who perceiving in themſelves a taſte and talents for the ſtudy of ancient monuments, are obliged in order to raiſe a ſmall revenue out of it, to devote themſelves to the ſuperficial inſtruction of travellers, and therefore want the neceſſary leiſure for reſigning themſelves up to ſtudies which are too often very unfruitful: Being thus made jealous of each other, left deſtitute of every motive of a noble emulation, and leſs attentive to acquire new knowledge, than to ſupplant one another, it is ſeldom that they make any conſiderable progreſs, and the greater part of them remain in a ſtate of mediocrity.

Can it be believed that throughout all Italy, where the ſmalleſt towns have a literary academical ſociety, which employs itſelf in the ſtudy of eloquence and poetry, there is but one ſingle academy of antiquities *, and one of ſciences? Both the one and the other too owe their birth to the zeal of two individuals for the glory of their country. The firſt, eſtaſtliſhed ſome few years ſince at Cortona, on the frontiers of Tuſcany and the eccleſiaſtical ſtate, by the care of the late marquis Venuti, brother to the abbe of the ſame name, whom I have mentioned above, is yet ſupported only by the zeal of its members, and has already ſent into the world ſix volumes of diſſertations: the other, which is more ancient, and better known under the name of the inſtitution of Bologna, is the work of the famous count Marſigli, who was at once

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* The academy of Naples was not yet eſtabliſhed in 1755.

once its ſounder and benefactor. He purchaſed the palace for its reception, and has bequeathed to it the celebrated collection of natural hiſtory and antiquities of Ulyſſes Aldovrandus, which had been bought and conſiderably augmented by him. The reigning pope alſo, who is a native of Bologna, and was archbiſhop of it at the time that the Tiara crown'd his virtues, honours with his particular protection an eſtabliſhment which diſtinguiſhes that city above all the other cities of Italy. They count there four and twenty penſioners, called Benedetti, from the name of their foundation.

Among the other favours which his Holineſs was pleaſed to confer on me, the letter of recommendation iſſued out by him, at his own proper motion, by virtue of which the academy of Bologna did me the honour of admitting me into their illuſtrious body, without waiting till the number of places preſcribed by their regulations ſhould become vacant, is not to be reckoned among the leaſt.

No church throughout the whole chriſtian world has leſs need of foreign ornaments than that of St. Peter at Rome, eſpecially ſince twenty popes, to count only from the time of Sextus V. have with a generous emulation conſecrated their treaſures towards the embelliſhment of that edifice. The old cuſtom, however, ſtill prevails, and ſtrangers ſee with regret and ſurpriſe, that on great ſolemnities they ſtill cover the pilaſters of the baſilico of St. Peter with hangings that are rich indeed, but the materials and colour of which interrupt the harmony and proſpect of a majeſtick piece of architecture, and deprive the eye of a ſight of its marble lining and thoſe other ornaments of ſculpture, with which the interior part of that temple is decorated. But be that as it will, this cuſtom of hanging and unhanging ſo often the church of St. Peter, joined with the difficulty of reaching up to its roofs, or even to the arcades of the lower ſides, furniſhes the Italian artiſts with frequent opportunities of exerciſing their talents in the mechanical way. The engraved collection of ingenious and commodious machines, invented in part for the church of St. Peter, by Zabaglia, a perſon of genius, though but a plain carpenter by profeſſion, is well known. In the month of April 1756, I ſaw one made by the ſeignor Giovanni Corſini Roni, but of a conſtruction as ſimple as elegant, which had juſt been ſet up for the reparation of the inſide of the dome of the Pantheon. This ſupplied with advantage the expenſive apparatus of thoſe ſcaffolds, of which we are ſo prodigal in France, on the like occaſions. It was no more than a ſimple pair of ſteps, about ſeven or eight feet broad, and ſuſpended to the ſummit of the dome. Theſe ſteps were borne along in a quadrant of a circle, concentrical to the interior part of the dome, and were preſerved in their curvature by an aſſemblage of carpentry work, like that of the cinctures which are uſed in the conſtruction of roofs; but with this difference, that here, for the greater lightneſs, ſtraight boards, laid, however, acroſs, ſupplied the places of ſquare pieces of timber. The ſummit of the arc was paſſed through by an iron bolt, which at the ſame time performed the office of a pivot,

vot, and ſuſpended by the ſame bolt, placed diametrically over the circular opening in the midſt of the cupola, by which the church received its light. The foot of the ſteps was furniſhed with rollers, and placed on the cornice of the dome. The whole of this machine, which was near ſeventy feet high, moved ſo freely, that it yielded to the firſt impulſe, in going round the cornice; and as it moved about ſix feet at a time, the workmen were able to transfer themſelves with as much convenience as ſafety to all the heights, and all the different ſides of the roof. I underſtand that there is to be ſeen at Paris a model of this machine, in the poſſeſſion of M. Trouart, a young architect, who brought it from Rome.

The ſpectacle which at preſent forms the amuſement of the people of Rome, retains nothing of the barbarity of the ancient combats of Gladiators. Some of the princes and Roman noblemen amuſe themſelves by keeping horſes purely for the courſe: not as in England, backed by a rider, but alone, at full liberty, and entirely delivered up to their natural ardour and that kind of emulation which the concourſe of people aſſembled ſeems to inſpire into them *. Eight or ten horſes, commonly barbs, of a ſmall ſize, and mean figure, retained on the ſame line by a rope extended about the height of their breaſt, ſet off at the inſtant when they let this rope fall. In the races at carnival time, which are the moſt ſolemn, the courſe is uſually in the long ſtreet at Rome, to which this exerciſe has given the name of the Rue de Courſe, or Race-ſtreet; by the Italians

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[*] At Florence, in order to increaſe the ſpeed of the horſes, which there alſo run alone, without a rider to direct them, they place a large piece of leather, ſomewhat in form of the wings of a ſaddle, on their backs, ſtuck full on the inſide with very ſharp prickles. The barrier being formed, and every thing ready for the race, the ſpectators immediately ſet up a loud ſhout, at the noiſe of which the horſes affrighted ſtart off, and the prickles in the flapping leather on their backs ſtill continuing to goad them more and more as they run, their ſpeed is thus urged to the higheſt pitch their nerves will allow, till the goal at length happily puts an end to it, by terminating at once the conteſt and their pain. The barrier they run in is formed by a ſtrong railing, about breaſt high, with a rope at either end, to keep the horſes within the bounds, and the ſpectators are all placed on ſeats with ut.

Italians called il Corſo. They take care at ſuch times to gravel it over: its length is 865 toiſes *. I obſerved twice by means of a watch for ſeconds, and the help of a ſignal, that this diſtance was run over in 141 ſeconds, which makes near 37 feet a ſecond. A little reflection will make this ſpeed appear much more conſiderable than at firſt we may imagine it to be.

It is evident that we cannot ſuppoſe more than two leaps or progreſſions on gallop to one ſecond, ſeeing that each of theſe leaps requires at leaſt three very diſtinct points of time: viz. that in which the horſe lifts himſelf from the ground, that in which we ſee him cleaving the air, and that in which he deſcends again; and that theſe two bounds, thus ſuppoſed to be made in every ſecond, require ſix definitive moments, a period ſcarce perceptible in ſo ſhort a ſpace of time. Theſe horſes, which are but of an inconſiderable ſize, and whoſe ſwiftneſs every ſecond

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* That is to ſay from the rope of the extended barrier, which is 74 feet beyond the obeliſk, to the *Porta del Popolo* at the ſaliant angle of the palace *de Veniſe*.

cond is equal to thirty-ſeven feet, paſs then at each bound over a ſpace of more than eighteen feet, which is very nearly equal to four times the length of their body taken from the breaſt to the tail *. It is true, indeed, that this length is more than doubled by the extenſion which their outſtretched gallop gives to their limbs before and behind. All this conſidered, how can the fleetneſs of the Engliſh horſes be by a great deal greater, as it is known in reality to be? But there are certain caſes wherein the truth ſurpaſſes all the bounds of probability, and of this kind is that at preſent under our conſideration.

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* It is upon principles of this kind that naturaliſts prove a flea, comparatively ſpeaking, to be the ſtrongeſt, as well as the ſwifteſt animal in being. For as ſwiftneſs depends upon a ſtrong conformation of the muſcles, of which we have a remarkable inſtance in the hind legs of a hare, from whence it is well known, that, like deer, greyhounds, and other quadrupeds, ſhe derives her velocity; and as this ſwiftneſs again is to be meaſured by the diſtance they throw themſelves at every bound, compared with the length of their bodies; if we examine the ſpeed and ſtrength of a flea by this method of reaſoning, we ſhall find that inſtead of four, it is able to throw itſelf at leaſt forty times its length; a force and velocity ten times greater than that of the barbs at Rome.

The late M. Dufay writ in 1737, from Newmarket, that the courſe there of four Engliſh miles *, of which he had been an eye-witneſs, had been compleated in leſs than eight minutes by four or five ſeconds. Theſe miles are 826 of our toiſes, which makes more than 41 feet $\frac{2}{3}$ in a ſecond, or near five feet more than the barbs at Rome; and we muſt alſo remark here that theſe latter run at full liberty, whereas the Engliſh horſes are burthened with the weight of a rider †. This fleetneſs, however, of 41 feet $\frac{2}{3}$, is ſtill but an ordinary degree of ſwiftneſs there, inaſmuch as of ten horſes which ran together, the very hindmoſt of them was no more than twelve or fifteen paces from the end of the courſe. Beſides, it is aſſerted that the ſame courſe has been frequently run over in ſix minutes and ſix ſeconds. I have this as a fact from a gen-

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* The Engliſh mile was fixed by Henry VII. at 1760 yards or rods of three feet each, conſequently this mile contains 5280 Engliſh feet, which are equivalent to 4957 of the Paris meaſure, or to 826 of our toiſes; the proportion of the Engliſh foot to ours being as 1352 to 1440.

† The author might have added, that theſe riders alſo frequently carry weights.

a gentleman who has often been concerned in the races at Newmarket *; and this ſwiftneſs, which would amount to more than fifty-four feet in a ſecond, is to that of the barbs nearly as three to two. We muſt alſo obſerve, that inſtead of one Engliſh mile, or very little more, to which the courſe at Rome is limited, that of Newmarket is four miles, a ſpace too long for the ſwiftneſs of any horſe to preſerve itſelf through on a ſenſible equality. It is evident that this ſwiftneſs muſt abate towards the end of the courſe, and conſequently that in the firſt moments of the race its maximum muſt be at leaſt upwards of fifty-four feet in a ſecond. We are likewiſe aſſured that a famous horſe, called Starling, has ſometimes performed the firſt mile in a minute, which would make 82 feet ½ in a ſecond; a degree of ſwiftneſs inconceivable, even though we ſhould ſuppoſe it to be exaggerated, as there is great appearance it is: But this is a point on which I expect ſome

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* Mr. Taaffe, now at Paris. [This gentleman is ſince dead.]

ſome further elucidations[*]. It would be ſufficient that this ſwiftneſs ſhould laſt only a few ſeconds, in order to enable us to ſay without any exaggeration, that ſuch a horſe went ſwifter than the wind, as it is ſeldom that the moſt violent wind makes as much ground in the time. For the greateſt ſwiftneſs of a ſhip at ſea has never been known to exceed ſix marine leagues in an hour; and if we ſuppoſe that the veſſel thus borne partakes one third of the ſwiftneſs of the wind which drives it, the latter would ſtill be no more than eighty feet a ſecond.

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[*] The following are the elucidations I have received, ſince the reading of this memoir, from M. (Dr.) Maty, keeper of the library in the Britiſh Muſeum, and author of a periodical work in French, which is greatly eſteemed, entitled *le Journal Britannique.* "There are (ſays Dr. Maty) two courſes at Newmarket, the long and the round: the firſt is exactly four Engliſh meaſured miles and 380 yards or more; that is to ſay, 7420 yards or Engliſh rods, or 3482 of our toiſes. The ſecond is not four Engliſh miles by 400 yards; that is to ſay, it is 6640 yards, or 3116 toiſes, Paris. Childers, the ſwifteſt horſe ever remembered, has run the firſt courſe in ſeven minutes and a half, and the ſecond in ſix minutes forty ſeconds, which amounts to 46 feet five, or nine inches French, in the ſecond: whereas all other horſes ſince the foregoing, take up at leaſt ſeven minutes and fifty ſeconds in compleating the firſt and longeſt courſe, and ſeven minutes only in the ſhorteſt, which is 44 feet, five or ſix inches, the ſecond. Theſe (Dr. Maty adds) are facts, which I believe to be true. I muſt alſo add, that it is commonly ſuppoſed, that theſe courſers cover at every bound, a ſpace of ground in length about 24 Engliſh feet." This is little wide of my conjecture of two bounds in the ſecond. Every bound in this caſe would be about 18 royal feet and a half, for the fleeteſt barb in Rome and twenty-two or twenty-three feet royal for the Engliſh running horſes; ſo that the ſwiftneſs of the latter to that of the barbs, is very nearly as four to three.

I departed from Rome on the 22d of April 1756, and took the road to Loretto. I ſaw on the way the celebrated caſcade of Terni, to which Miſſon, a pretty exact traveller, gives the height of three hundred feet. I do not believe it has been ever meaſured with preciſion, and the local circumſtances of its ſituation render the affair difficult: I ſhould not give it above two hundred feet on a compariſon of its total height with that of a part of it, which I myſelf attempted to meaſure. This caſcade appears three times higher than that of Tivoli. The caſcade of the iſle of Sora, which is leſs known, becauſe farther removed out of the high road, and which I went expreſsly to ſee in my return from Naples, is the loweſt but the wideſt of the three. The Garigliano, which is formed by the reunion of the Lyris and the Fibreno, at one mile's diſtance below this junction, divides itſelf into two branches, in the place where it meets the rock which forms that iſle, and precipitates itſelf downwards by two caſcades; the one perpendicular, about ſixty feet high and forty broad, the other much leſs rapid, but the ſight of which is not leſs ſingular, nor leſs agreeable to the eye.

On the 27th of April, being at Loretto, I ſaw the ſun riſe from beyond the Adriatick, at about four degrees ½ Eaſt by North of the compaſs, from whence I concluded the declination of the needle to be fifteen degrees thirty-five minutes from North to Weſt. I had hoped to have ſeen, at the riſing of the ſun, the mountains of Dalmatia, on the other ſide of the gulph of Venice; but the fogs hindered me from diſtinguiſhing them both that and the ſucceeding days, for the whole length of the coaſt, which I followed from Ancona as far as Ravenna. By means, however, of the enquiries which I made, I found in theſe cantons ſeveral perſons, who aſſured me, as being eye-witneſſes, of another fact, of which till that time I had been uſeleſsly informed: this was, that there are ſeveral points of the Apennine, on the frontiers of the Eccleſiaſtical ſtate, of Tuſcany, and the duchy of Modena, from whence we may ſee the two ſeas which bound Italy to the Eaſt and Weſt *. It was not a vain curioſity which induced me to aſſure myſelf of this fact; but the advantage that might be drawn from a concurrence of circumſtances, rare, and perhaps only there to be met with.

We have had within theſe twenty years, five different menſurations of the Latitude † of the earth, but we have hardly one of its Longitude §. The apparent impoſſibility

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* Among others, from a ſummit near Borga San-Sepolcro; and a convent of Camaldulians, near the ſources of the Arno, between Valiombroſo and Bagno, on the frontiers of Tuſcany and the Eccleſiaſtical ſtate; and laſtly from Mount Cimone, near Seſtola.

† In Lapland, Peru, France, at the Cape of Good Hope, and in Italy, compleated in 1737, 1740, 1742, 1752, and 1755.

§ By Meſſ. Caſſini, de Thuri, and de la Caille, on ſibility of attaining to a ſufficient degree of preciſion, for want of our being able to find an arc large enough *, parallel to the Equator and fit for meaſuring, has almoſt made us deſpair of this method. But if any place in the world ſeems to unite all the moſt favourable circumſtances for meaſuring an arc in Longitude, it is in this part of Italy.

A ſignal placed on one of the ſummits of the Apennine, from whence we may ſee the Adriatick to the Eaſt, and the Tuſcan ſea to the Weſt, cannot fail being perceived from one coaſt to the other, provided it be of a ſufficient magnitude. I ſuppoſe, for inſtance, that it may be ſeen from Ravenna or Rimini on one ſide, and from Leghorn or Piſa on the other. Here then we have an arc of more than two degrees

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on the coaſts of Provence and Languedoc, in 1742. See the book entitled, the Meridian of Paris Verified, page 105.

[*] The error to be apprehended in this meaſure, with reſpect to the inſtant of the appearance of an inſtantaneous ſignal, not being greater on a large arc than a ſmall one, will make it by ſo much the leſs in every degree, as its arc contains a greater number.

degrees in Longitude, and eaſy to be meaſured: but this is not all; for that diſtance may at leaſt be doubled, of which the following is a proof: from the intermediary ſummit of the Apennines, from whence we ſee the two ſeas, one to the Eaſt, the other to the Weſt, the ſight can be only bounded by the objects which terminate the horizon of the ſea, and which are perceived on both ſides. From this ſame ſummit then we ought neceſſarily to ſee in clear and ſerene weather the ſun riſe from behind the mountains of Iſtria and Croatia, and ſet beneath thoſe of Genoa. Conſequently a ſudden flame of a ſufficient volume, produced either by a maſs of gunpowder, as was propoſed by me in 1735*, and was actually carried into execution in 1740, or by a bomb of paſteboard placed on the ſummit of the Apennine, choſen for that purpoſe, might in a fine night be ſeen by two perſons appointed to obſerve it, with each a regulator by him; the one at Monaco, or the mountains on of Genoa, the other on Cape Pola [in Iſtria, near Trieſte. The difference of the hour in which each of them would perceive this artificial phenomenon, will give the difference of the Meridians of the two obſervatories, and the meaſure of an arc nearly five degrees in Longitude.

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* See Memoirs of the Academy of Sciences for 1735, page 1; and the Meridian of Paris Verified, page 98.

Though we ſhould be able to aſſure ourſelves of this difference of the hour but nearly within a ſecond* [I am of opinion,

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* I have found by experience, beneath the Equator, where the ſtars riſe perpendicularly, and with very great rapidity, that it is not difficult, by taking ſeveral correſpondent heights, to inform one's ſelf with certainty of the inſtant of noon, and above all of the mediation of a ſtar nearly within a ſecond; and experienced obſervers will find perhaps that we may attain to a greater preciſion. This half-ſecond of time anſwers to an arc of a degree of ſeven ſeconds and a half, which we may eſtimate beneath the Equator at one hundred and twenty toiſes, and which would be reduced again to eighty-four toiſes, under a parallel of forty-four degrees and a half. Now an error of eighty-four toiſes in an arc of five degrees, would not produce one of ſeventeen toiſes to a degree, inſtead of thirty-four, which I have ſuppoſed; the following is the reaſon of it: The difficulty of determing the hour exactly by correſpondent heights increaſes in an oblique ſphere, where the apparent motion of the ſtars is ſlower; and increaſes preciſely in the ſame proportion as the obliquity of the ſphere,

however, that it is poſſible to attain a much greater degree of exactneſs, if we
take

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or in an inverſe ratio to the coſines of latitude. Thus, for example, beneath the parallel of ſixty degrees, the radius of which is ſubduple to that of the Equator, the ſuppoſed arc of ſeven ſeconds and a half would be by a moiety ſhorter, and conſequently would be only ſixty toiſes inſtead of a hundred and twenty; but the difficulty of taking the hour exactly would be alſo as great again beneath this parallel, and inſtead of an error of half a ſecond, which we ſuppoſe might be made under the Equator, there would be under the parallel of ſixty degrees an error of one ſecond of time to be apprehended, which anſwers to fifteen ſeconds of a degree. Now an arc of fifteen ſeconds of a degree half as little, is equal in length to an arc of ſeven ſeconds and a half in a degree that is as large again. This would make us then an exact compenſation for it, and the error to which we ſhould be expoſed in the determination of the hour, will be the ſame under any parallel that we proceed upon: A circumſtance which has not, that I know of, been remarked, or at leaſt not explained, till now. It follows from thence, that the exactneſs of the aſtronomical menſuration of an arc of Longitude may be equal in every country, and that it depends only on the length of the arc in toiſes, whatever be the number of its degrees. If I were to confine myſelf then to the ſuppoſition of half a ſecond, at which I eſtimate, from my own experience, the error poſſible to be committed in the determination of the hour, by correſpondent heights, beneath the Equator, this error would not be proportionally more than forty-two thirds for the parallel of forty-four degrees and a
half

take all the neceſſary precautions, and eſpecially if the obſervations are often repeated] yet this error of a ſecond in time, which is equivalent to fifteen ſeconds of a degree, amounts not in a parallel of forty-four degrees to one hundred and ſeventy toiſes, which, being divided again among five degrees, would make only thirty-four toiſes error to a degree; conſequently, the mea-

half, and would produce, like that of half a ſecond beneath the Equator, only an error of a hundred and twenty-toiſes on an arc of five degrees; which would be no more than twenty-four toiſes to a degree, inſtead of thirty-four, which I have computed. But as the method which I have propoſed requiers two obſervers, and it might happen, abſolutely ſpeaking, that their errors, inſtead of being none at all or leſs, which I have not ſuppoſed them, might be as great as it is poſſible for them to be, and that inſtead of compenſating one another they might be doubled, though repeated and multiplied obſervations might be a remedy, morally ſpeaking for this accident, yet I have ſuppoſed the total error of the two obſervers to be a whole ſecond, even on taking a medium between their ſeveral obſervations. This ſecond anſwers not to a hundred and ſeventy toiſes on the parallel of forty-four degrees and a half, and yet it is on the ſuppoſition of that error, which ſurpaſſes all the bounds of probability, that the error in a degree would be, and hardly, thirty-four toiſes. It is evident then that the propoſed menſuration in Longitude is ſuſceptible of as great, or even a greater preciſion, than that of three degrees of the Meridian.”

ſure of this arc of five degrees in Longitude, would afford as much or more preciſion than our menſuration of three degrees of the Meridian, which I think I have proved we can anſwer for, to within very near forty toiſes*.

If Father Ximenes, the reſtorer of the Meridian of Florence, be commiſſioned to make a map of Tuſcany, and to meaſure there an arc of the Meridian, his Geodeſian meaſures, joined to thoſe of the fathers Maire and Boſcovick, will extend from one ſea of Italy to the other, and go a great way towards taking the propoſed menſuration in Longitude, which is ſo well calculated to furniſh us with new lights, reſpecting the figure of the earth.

My firſt care on my arrival at Bologna was to acquit myſelf of the acknowledgements which I owed to the gentlemen of the Inſtitution. The count of Caſali, one of the profeſſors, and M. Zanotti, perpetual ſecretary to that illuſtrious body, were ſo kind as to give themſelves the trouble of accompanying me wherever I went. We ſee at Bologna aſſembled in one palace, what, in London, and in Paris, is found diſperſed in all quarters of the town, a publick library, enriched every day with new donations from the holy father; an obſervatory; cabinets of natural hiſtory, experimental phyſicks, mechanicks, medals, and antiquities; vaſt collections and anatomical preparations, natural and artificial; halls for academies of painting, ſculpture, and architecture, both civil and military, ornamented with plans in relief and models of machines uſed in war; cabinets of geography and navigation: in ſhort, every thing which can preſerve a taſte for the arts and ſciences, and facilitate the progreſs of knowledge in the human mind. I was preſent at ſeveral academical lectures and diſcourſes. One of their profeſſors of anatomy is Madam Laura Baſſia, a lady extremely well verſed in the Greek and Latin languages, and wife to M. Verati, another celebrated profeſſor. She is not the only lady in Italy, who in our days has procured herſelf a name in the republick of letters by her genius and knowledge. We are all acquainted with the treatiſe on the calculation of differences, by the learned Madam Agneſi of Milan, who has juſt buried her talents in a cloiſter; and the learned tranſlations of Madam Ardinghelli of Naples who at the moſt tender age diſtinguiſhed herſelf by her progreſs in phyſicks.

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* See the meaſures of the three firſt degrees of the Meridian, printed at the Louvre in 1751. p. 232.

Independently of the luſtre which ſo fine an eſtabliſhment as that of the Inſtitution diffuſes over Bologna, that city is one of the largeſt and moſt beautiful in all Italy. Every thing contributed to render my abode there agreeable, and indeed I ſhould have needed for that purpoſe nothing more than the ſingle houſe of the Felt-marſhal Palavicini, late governor of Milan, who who had made choice of Bologna for his reſidence, and from whom I received, without any letter of recommendation, the moſt flattering advances in my favour. Bologna firſt ſet the example, which the greateſt part of the cities of Italy have ſince followed for theſe twenty years paſt, in eſtabliſhing a Caſino. This is the name which they give to a large handſome houſe, furniſhed and maintained at the common expence of the nobility of the city. The beſt company of both ſexes aſſemble there every evening, and ſtrangers of note, when once they have been preſented, are afterwards admitted. Bologna is governed as a republick by the authority of a ſenate. The popes, to whom this city ſubmitted herſelf voluntarily many ages ago, enjoy there the honours and the ſovereignty; but the Bologneſe have preſerved their privileges. They have an ambaſſador in ordinary at Rome, and unite the advantages of a republican form of government to thoſe of monarchy.

I have ſpoken above of the Meridian of Bologna, and its leaning tower, which attracts the attention of travellers.

After taking a haſty view of Reggio, Modena, and Parma, and believing myſelf in France at Colorno, where I had the honour of paying my court to his royal highneſs the infant duke of Parma, and likewiſe to the infanta, I paſſed on to Mantua and Ferrara, from whence I repaired to Venice at the end of May, in order to be preſent at the ceremony whereby the doge annually eſpouſes the Adriatick, a time there of feſtivity and tumult, and very ill adapted to obſervations which require eaſe and tranquillity.

Amidſt the ſeveral curioſities which they ſhow to ſtrangers, in the ſmall arſenal at Venice is a piece of cut velvet, on a ground of gold, as ſingular for its workmanſhip as its antiquity. This was a preſent of Uſſum Caſſan, king of Perſia, to the republick of Venice, to which he ſent ambaſſadors in 1572. The gold ground is of a flattened ſtuff, as if it had been paſſed under the cylinder; the fur of the velvet, however, is raiſed; it repreſents not branches or flowers of ſtriking colours like ours, but human figures, pretty well deſigned, and the draperies and carnations of which have ſhades enough to imitate the natural. This effort of art, which we ſhould find it difficult perhaps, at this very day, to puſh farther, may enable us to judge how very long ago that of working ſilk has been carried to perfection in the Eaſt. And what proves clearly the ſuperiority of the Orientals in this kind of workmanſhip, or at leaſt their great progreſs in it before the Europeans, is that this preſent of a powerful monarch to the republick of Venice, ſuppoſes evidently, that this ſpecies of velvet manufacture was unknown in that city, at a time when her ſilken manufactures, which had made thoſe of Greece decline, were at their higheſt degree of reputation.

The art of making ſilk tiſſues, which is very ancient in the Eaſt, had paſſed over into Europe under the Roman emperors. But being baniſhed into the remoteſt parts of Aſia, after the invaſion of the Barbarians, who deſtroyed the empire, this beautiful art was brought back again to Conſtantinople, in the ſixteenth century, by ſome monks who were on their return from Serinda, which lies between the rivers Indus and Ganges. The manufactures of ſilken ſtuffs eſtabliſhed in Greece, and tranſported into Sicily by Roger, about the year 1148, were brought to perfection at Lucca, at Bologna, and at Venice, in the following century, three hundred years before the firſt pair of ſilk ſtockings, which were preſented to Henry II. appeared in France. They knew then that the leaf of the mulberry-tree was the moſt proper food for ſilk-worms, but they erroneouſly imagined, that mulberry-trees would not grow any where but in a warm climate; and this ſingle prejudice deferred for many ages their tranſplantation from Sicily and Calabria into the North of Italy. Since thoſe times we have ſeen them ſucceed extremely well in France, and even in countries ſituated much farther to the North: An inſtance which ought to encourage all proper endeavours to naturalize in our climates ſuch uſeful productions as nature has refuſed us.

From Venice I took the route of Turin, but ſtayed only a few days at Padua and Milan, the latter of which is one of the moſt pleaſing cities in Italy to ſtrangers, and that wherein the French are the leaſt ſo of any; the manner of living there comes up much nearer to that of Paris than in all the other cities of Italy.

The celebrated Ambroſian library contains, among other treaſures, between nine and ten thouſand ancient manuſcripts, a great number of which are oriental, and brought from Greece, Syria, and Egypt. They are all bound up, but without titles, and diſtinguiſhed only by their numbers. We perceived there thoſe of which the fathers Mabillon and Monfaucon have taken notice. The famous Muratori, in his vaſt collection of Italian hiſtorians, has publiſhed ſome, and made uſe of ſeveral others: The reſt are unknown. They keep them ſecret, and do not even as much as ſhow the catalogue of them to ſtrangers; which might make it ſuſpected that this catalogue is imperfect. If the intention of the founder * had been followed, and but for a century and a half ago ſixteen perſons of learning verſed in the ſeveral kinds of literature, and a knowledge of the oriental languages, had applied themſelves to decypher, ex-

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* Cardinal Frederick Borromeo, archbiſhop of Milan, couſin to St. Charles and his ſucceſſor.

plain, and publiſh theſe manuſcripts, the republick of letters would long ſince have reaped the fruit of their labours; but for want of ſufficient funds, there are at preſent but three doctors maintained to look after this library, and thus the greateſt part of the treaſures contained in it remains buried in obſcurity.

I ſaw in a cabinet of pictures annexed to the Ambroſian liberary, a numerous collection of deſigns for machines, executed and invented by Leonardo da Vinci, a cotemporary and rival of Michael Angelo. It is well known, that Leonardo being invited into France by Francis I. expired in the arms of that prince, on receiving his viſit. To the merit of a good painter, he joined alſo that of a good mathematician, for the age he lived in.

His maſter-piece in painting is a picture in freſco, repreſenting our Lord's ſupper, with his twelve apoſtles, a little larger than the life. This piece is twenty feet long, by ten high. It is to be ſeen at Milan in the refectory of the Dominicans. It is ſurpriſing to find a picture now ſo freſh, which appeared ſo black and defaced to Miſſon, eighty years ago, that this traveller aſſures us, he was not able to make out any part of it. The preſent colouring, indeed, is not at all like that in the other works of Leonardo. It is not ſufficient then to ſuppoſe, that within theſe twenty-five or thirty years paſt this picture has been cleaned by any unknown ſecret, as travellers ſay; but it muſt alſo have been painted over entirely anew. This I have been well aſſured of from very good authority. There is great appearance, therefore, that the beautiful diſpoſition, the choice of attitudes, the diſtribution of the figures, in one word, that the compoſition is at preſent the only thing in this picture which belongs with certainty to its firſt author. It will not be deviating far from the object which I propoſed to myſelf in this memoir, if I remark that not only the rules of perſpective, which are too often neglected by the greateſt painters, are regularly obſerved in this, but alſo thoſe of opticks. We may judge of the truth of this aſſertion by the different poſition of the points of light which are variouſly reflected by the chryſtal veſſels according to their different form, or as their ſituation is more or leſs oblique with reſpect to the ray of light which ſtrikes them.

I ſaw at Turin ſome experiments that were new to me, relative to the effects of gun-powder; and likewiſe two machines, which appeared to me very ingenious: the firſt was a wind-gun, which they loaded by ſetting fire, by means of a touch-hole, to two ounces of powder encloſed in a very thick cylinder of braſs: this train, in communicating the fire through a very narrow channel, burns a thread which ſhuts up with a trigger the entrance of the chamber where the powder is put: the latter thereon takes fire without any exploſion, and the air being dilated by this inflammation, preſerves its ſpring for ſeveral months. They cauſe alſo a ſmall portion of it to paſs into a ſecond chamber by opening a partition which ſhuts up again immediately, and this little portion of the flame is ſufficient to drive, on pulling down a trigger, a leaden ball ſixty paces off. They can fire eighteen times ſucceſſively in this manner, but each time with a diminution of its force.

The other machine is deſigned to meaſure the ſtrength of the powder, which ſtill keeps on burning in the cloſed cylinder of braſs. The dilatation of the air produced by this inflammation, cauſes the water contained in the bottom of the ſame cylinder to aſcend to a certain height in a glaſs tube fitted thereto. They then ſuffer the air to enter again by applying to the cylinder a treading pump; and we thus ſee how much of the inflamed ſpirit is neceſſary to condenſe the air contained in the cylinder, in order to make the water aſcend in the tube of graduated glaſs, to the ſame degree as the firing of the powder had raiſed it. The inventor of theſe machines is M. Mathi, penſionary of the king of Sardinia.

In the cabinet of natural hiſtory belonging to M. Donati, profeſſor in the univerſity of Turin, I ſaw ſeveral petrified trunks of trees, which had been dug up out of the mountains of Genoa. Theſe leave us no room for ſuſpicion as to the reality of their petrifaction.

I paſſed over Mount Cenis: on the 4th of July 1756, all the ſnows there were not diſſolved; and on the 14th of the preceding month the waters of a little lake abounding in trout, ſituated on the height of a defile, through which the high road leads, were ſtill frozen over.

As Mount Cenis paſſes for one of the higheſt mountains of Europe, I was deſirous to make ſome experiments there on the barometer, and to compare the height which I ſhould obſerve the mercury at in that place with thoſe which I had remarked on the loftieſt mountains of Peru. Accordingly I aſcended the moſt elevated ſummit near the road to the right, about fifteen or ſixteen hundred toiſes from the pond abovementioned, and from the hoſpital of the Pelerins. I had already got as high as the village of Novaleſe, after three hours travelling on horſeback, through a road which had been newly repaired. I aſcended again on foot for the ſpace of near four hours more, and the laſt of them through a dry ſoil, interſperſed with fragments of rocks, broken into leaves, and conſiſting of a ſpecies of Schite-ſtone, or rough baſtard ardoiſe, which were only interrupted by maſſes of ſnow in ſuch places as were moſt hollow. There wanted ſtill twenty toiſes of perpendicular height, before I could have attained the top of the mountain; when in croſſing a hollow way covered with ſnow, and the ſides of which were pretty ſteep, I perceived my foot fail under me. All I could do was to throw myſelf backwards on my breech: I ſlided in this poſition the length of twelve or fifteen toiſes, driving down the ſnow before me with hands and feet, in order to retard the rapidity of my fall; (I am entering here into a detail of what may not be unſerviceable on a like occaſion) I ſtopped where the bed of ſnow ended, and where the fragments of the rock began: I got off for a contuſion on my foot and a few ſcratches. I regained then, not without difficulty, the foot of the rock, where the peaſant had remained who ſerved me as a guide, and I conſoled myſelf for the accident that had befallen me, on finding my barometer in good condition. It was now near noon: I obſerved the height of the mercury to be nineteen inches ten lines and a half*, that is to ſay, a line and three quarters lower than at Quito in Spaniſh America, near the Equator, where by a great number of experiments we fixed the medium height of the mercury at twenty inches and ¼ of a line †, a height equivalent to 1460 toiſes above the level of the ſea: whence I conclude that the place where I actually made this laſt experiment was not above thirty toiſes higher than the ground at Quito, the level of which ſurpaſſes by more than twenty toiſes the very utmoſt top of the Canigou §, the higheſt mountain of all the Pyrenees. It is true that I ſaw from the place where I fell ſome points of Mount

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* This experiment was made with the portable barometer broke at Mount Veſuvius, and which I had got mended at Rome. I have compared it, ſince my return to Paris, with the beſt conſtructed and moſt accurately divided barometers, and have rectified my obſervations of the heights by them.

† See in the Hiſtorical Journal of a Voyage to the Equator, printed at the Louvre in 1751, the Latin inſcription left at Quito, page 163.

§ The Canigou is 1440 toiſes high, according to the geometrical menſuration of M. Caſſini. The mercury

Cenis, which were higher than thoſe that I was then labouring upon; but the difference was not conſiderable, and amounted not to fifty toiſes, as far as I was able to judge of it.

On my return to the hoſpital of the Pelerins, I obſerved there the height of the mercury in the ſame barometer, at three o'clock in the afternoon, to be 22 inches and half a line: that is to ſay, 26 lines more than at my ſtation on the top of the mountain, which amounts to near 500 toiſes difference in the height of the two places.

Mount Cenis, therefore, muſt neceſſarily be the higheſt mountain of the Alps. Yet the White Mountain *, which we ſee from the banks of the lake of Geneva, at fourteen or fifteen leagues diſtance to the ſouth-eaſt, and the upper half of which is always covered with ſnow, is incomparably much higher. M. Fatio de Duillier, who meaſured its height geometrically, makes it

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mercury roſe there in 1740 to twenty inches two lines $\frac{1}{4}$. See Obſervations on Natural Hiſtory, by M. le Monnier, phyſician, Meridian verified, page 224.

* They give this mountain ſeveral names.

it at the leaſt 2000 toiſes above the ſurface of the lake: and the latter again 426 toiſes above the level of the ſea, according to a calculation founded on the declivity of the Rhone, from its diſcharge out of the lake, by eſtimating this declivity at no more than double that of the Loire, meaſured by M. Picard: thus the total height of the White Mountain is, according to M. Fatio, 2426 toiſes above the ſea, which amounts within a very little to the height of the craggy and eaſtern ſummit of the volcano of Pitchincha, where I myſelf ſaw the mercury deſcend in the barometer to ſixteen inches*. But M. de Chezeaux, who meaſured a much larger baſe than M. Fatio, and who ought therefore to have attained a preciſion as much greater in the heights which he had deduced from thence, increaſes ſtill the altitude of the White mountain 250 toiſes. Suppoſing then the height of the lake Leman or Geneva above the level of the ſea to be juſtly calculated by M. Fatio at 426 toiſes, the abſolute height of the White

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* The city of Quito, ſince in a great meaſure demoliſhed by an earthquake, is ſituated at the foot of the volcano of Pitchincha, the higheſt ſummit of which exceeds the level of that city by about a thouſand toiſes.

Mountain will be 2676 toiſes; that is to ſay, upwards of 500 toiſes higher than the pike of Teneriffe, which has paſſed for the higheſt mountain of Europe *. The White Mountain is alſo ſeen from the environs of Langres at ſixty leagues diſtance, from whence they diſtinguiſh its ſummit covered with ſnow above the chain of Mount Jura. This prodigious height, which exceeds by 1200 toiſes that of the Canigou, ſtill comes not up to that of the higheſt mountains of the

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* Father Feuillee, a Minim, in his manuſcript voyage to the Canaries, makes the height of the mercury on the top of the pike of Mount Teneriffe about ſeventeen inches one line; this compared with the heights of the mercury but little different from it, which we have obſerved on the mountains of the Cordilleras of Peru, whoſe height was geometrically determined, makes that of the pike 2150 toiſes, being a more exact meaſure than that reſulting from the geometrical menſuration of the ſaid father Feuillee, who concluded it to be 2213 toiſes, by a baſe too ſhort and ill directed, and to the inclination of which alſo he paid no regard. For the reſt, although the higheſt of mountains, as concluded upon by the barometer, are uſually ſubject to great error, if we have not a correſpondent obſervation made at the ſame time on the level of the ſea, in the neareſt place; yet this circumſtance is not neceſſary in the neighbourhood of the Equinoctial line, where the variations of the barometer are very little: the greateſt of them at Quito hardly exceeding one line. Thus in the neighbourhood of the Equator, the height

the Cordilleras among the Andes of Peru; ſince of thirteen, the height of which I have calculated, ſeven are higher than the White Mountain, and Chimboraco in particular exceeds it by 550 toiſes, its height above the level of the ſea, meaſured geometrically, being 3220 toiſes*. In ſhort it is without controverſy the higheſt mountain known, and probably the higheſt in the whole world; Its inacceſſible part alone, from the foot of the perennial ſnow where I encamped, to the top, is 800 toiſes perpendicular height †.

The melting of the ſnows in ſummer, being ſuſpended every night in the gorges of

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height of the mountains may be pretty often determined by the barometer alone, to within ten or twelve toiſes nearly.

* See Menſuration of the three firſt Degrees of the Meridian, page 56.

† By very accurate experiments on the height of the barometer made at the ſame time at Geneva and Turin, as alſo at Turin and Genoa, on the ſea ſhore, and which were communicated to me by M. I. A. de Luc, a citizen of Geneva, while this memoir was printing, it appears, that the height of the lake of Geneva, taken at the ſurface of the Rhone, at its iſſue out of the lake, is no more than 1124 feet, or not 18 toiſes above the level of the ſea, inſtead of its being 426, which diminiſhes the height of the White Mountain 238 toiſes.

of the Alps, and renewed again every day during the hours in which the ſun is hotteſt, gives occaſion to very fantaſtical appearances. A valley in whoſe depth the eye is loſt, covered with rough pieces of ice, reſembling waves, and the whole ſurface of this ſea again congealed, and interſected here and there with deep crevices, the noiſe of a ſubterranean torrent which ſupports this enormous maſs, and changes the appearance as well as level of it from day to day; all theſe effects wrought by changes that are almoſt ſudden, and variouſly combined of heat and cold, can ſcarce be ſeen any where elſe in ſo eminent a degree: they form together a very ſingular ſpectacle, worthy the curioſity of naturaliſts, and calculated to furniſh new obſervations. Scheuchzer, in his Iter Alpinum, gives us a deſcription of the ice-valleys of Swiſſerland, which is the name they beſtow on thoſe immenſe maſſes of ice; but it appears that the ice-vallies of Savoy are very different from them. The moſt celebrated and moſt curious of theſe laſt is at three days journey from Geneva, towards the ſources of the Arve, at the foot of the

White Mountain. The way to it is through the valley of Chamogny. I was on the point of quitting Geneva, when I was informed of theſe particulars: the tour demands at leaſt eight days; it requires alſo preparations and conveniencies with which I was unprovided, and cannot be undertaken by one perſon only. Some Engliſhmen performed it in 1741, but without any mathematical inſtrument. M. Jallabert ſhowed me a ſhort relation of their journey, printed without the name of the author, and calculated rather to excite than ſatisfy curioſity.

This is not a place for me to teſtify my acknowledgements for the favourable reception which I met with from all the miniſters of France in the ſeveral courts of Italy where I made any ſtay, and the marks of kindneſs with which I was honoured by many of the cardinals at Rome: but the obligations I owe to the count de Stainville, ambaſſador then from France to his Holineſs, and the leaſt of which was that I reſided with him near a whole year; permit me not to defer my publick acknowledgements for the ſame.

| Meaſure of ſeveral ancient Roman Monuments, taken with the greateſt Accuracy | Royal, or Paris feet. | Preſumed number of ancient Roman feet. | Concluded length of ancient Roman feet. |
|---|---|---|---|
| | ft. in. lin. | | lines. |
| Width of the gate of the Pantheon, taken between the marble caſings of the jambs, - - | 18 5 4 | 20 | 131, 8 |
| Diameter of the Pantheon at the ſurface of the ground, taken between the axes of two oppoſite columns, and being a medium between the diameters N E, S O, and N O, S E; which differ from each other two inch, - - - | 137 2 0 | 150 | 131, 6 |
| Length of the portico of the Pantheon between the axes of the two fartheſt columns, - - | 98 9 9 | 110 | 129, 3½ |
| Height of the column called Antoninus's pillar, from the upper part of the chapiter to the bottom of the plinth of the baſe. - - - | 91 2 5 | 100 | 131, 3 |
| Height of Trajan's pillar, taken from the ſame, but not comprehending the fillet, - - | 91 6 10 | 100 | 131, 8½ |
| Length of the ſhaft of a pillar of one ſingle piece of granite, which was ſtill lying on the ground near Monte Citorio, in 1756. - - - | 45 6 2 | 50 | 131, 8 |

| | | | |
|---|---|---|---|
| Breadth of the facade of the building in the baths of Dioclesian, by M. Moreau, now member of the academy of architecture, $126^t$, $5^f$, $6^i$, - - | 761 6 0 | 840 | 130,5 |
| Side of the building of the ſaid baths by the ſame, 74. $o^f$, $4^i$, $6^l$, - | 444 4 6 | 490 | 130,5 |
| Length of the inſide of the great hall of the ſame baths, which at preſent forms the church of the charter-houſe, 30, $o^f$, 10, according to M. Moreau; and according to Deſgodets, $30^t$, $c^f$, $8^i$, $2^l$, - | 180 9 1 | 200 | 130,3 |
| The longeſt interior dimenſion of the circumference of Dioclesian's baths, taken on the ſide of the theatre, $178^t$, $1^f$, $2^j$, - - - | 1069 0 2 | 1175<br>1180 | 131,0<br>130,5 |
| The ſame in the baths of Caracalla, $198^t$, $3^f$, | 1191 0 0 | 1320 | 129,9 |
| Medium length of the ancient Roman foot, - | | | 130,9 |

If we allow 420 Roman feet diameter to the theatre of Marcellus, which Deſgodets has found to be 378 of our feet, the Roman foot will then contain 130,1 lines.

F I N I S.

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